

University of Canterbury

Knowledge for teaching  
mathematics in a primary school:  
Perspectives of pre-service  
teachers.

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## Abstract

Knowledge about how to teach remains a contentious issue in the preparation of final year pre-service teachers. This study, informed by the work of Shulman (1986) and Grossman (1990), examines knowledge for mathematics teaching by pre-service teachers. The context for this study was a mathematics education course, part of an Initial Teacher Education programme for primary teaching. Different categories of teacher knowledge distinguish between content knowledge and pedagogical content knowledge. There is considerable research about the knowledge needed for teaching mathematics from a teacher perspective, but limited research from a pre-service teacher perspective. This study focussed on knowledge that pre-service teachers develop and the processes they engaged in to construct knowledge for mathematics teaching.

This is a qualitative and interpretive study, where participants were third year pre-service teachers. Data collection tools were questionnaires and focus group interviews. One interview made use of an artefact, a curriculum plan for mathematics, generated by the pre-service teachers as they participated in the mathematics education course. A thematic analysis approach was used to analyse the data and to inform an emerging theoretical framework.

During this study, I developed a model that illustrates some important processes for pre-service teachers in a curriculum context. The Pre-service Teacher Development Model consists of three processes; *recognising*, *reconceptualising* and *realising*. These three processes illustrate how pre-service teachers develop knowledge about teaching mathematics in a primary school. The pre-service teachers identified the importance of mathematical curriculum and content knowledge in their preparation for teaching. This study also identified that the needs of pre-service teachers are unique. Whereas teachers with experience have a “privileged repertoire” of practices to draw on when teaching, pre-service teachers are beginning to develop this repertoire. This study serves to highlight the challenges for pre-service teachers as they prepare to transition to their first year of teaching.

## Abbreviations/ Glossary

ARBs: assessment resource bank items – a web based assessment resource available for teachers

Achievement objective: an objective for teaching curriculum content

Associate teacher: teacher appointed to support the learning of pre-service teachers during professional practices

Bachelor of Teaching and Learning: three-year degree qualification for primary teaching at The University of Canterbury

GLOSS: Global Strategy Stage assessment tool- a shortened version of The Diagnostic Test (Numeracy project resource).

Initial Teacher Education (ITE): the programme undertaken as preparation for teaching

Long-term plan: a yearly plan in mathematics based on the achievement objectives from Levels 1- 4 of *The New Zealand Curriculum* (2007)

*Mathematics in the New Zealand Curriculum* (MINZC): The curriculum for teaching mathematics, 1992 - 2007.

Pre- service lecturer: teacher within The Bachelor of Teaching and Learning degree

Pre- service teacher: a student undertaking an ITE programme

Primary School: A school for years 1- 8

Professional Practice: practicum component of the Bachelor of Teaching and Learning degree, typically five-weeks in duration.

“The Diagnostic Test”: The main Numeracy Project assessment tool

Teacher educator: teacher or lecturer teaching in a teacher education programme

*The New Zealand Curriculum* (2007): document outlining the curriculum to be taught in schools in New Zealand

The Numeracy Project: a New Zealand programme used in New Zealand schools for teaching the number strand of the curriculum

Tutor teacher: teacher appointed to assist and mentor beginning teachers in their first year of teaching

## Chapter 1: Introduction

Knowledge needed for teaching has been of interest to teacher educators because they are charged with the responsibility of preparing teachers to teach in the classroom. The seminal work of both Shulman (1986) and Grossman (1990) highlight the complexity of this knowledge. Shulman's work outlines several categories of knowledge, which have been refined by Grossman to include general pedagogical knowledge, subject matter knowledge, pedagogical content knowledge and knowledge of context (p. 6). Their work has influenced both policy and practice of Initial Teacher Education (ITE) programmes in New Zealand. The aim of this study is to investigate the areas of knowledge needed to teach mathematics in a primary school, and how pre-service teachers develop this knowledge within the context of an ITE programme. The context for this study is the Bachelor of Teaching and Learning degree, which is an Initial Teacher Education programme at the University of Canterbury. Mathematics education programmes within this degree aim to prepare pre-service teachers to teach the mathematics and statistics learning area of *The New Zealand Curriculum* (2007). This is an important area of the curriculum that all teachers in primary schools in New Zealand are expected to teach. This study focuses on the complexity of teaching mathematics, from the perspective of pre-service teachers.

In the field of mathematics education, several authors agree that the task of learning to teach mathematics is complex (Ball, 1993; Fennema & Franke, 1992; Hill, Sleep, Lewis & Ball, 2007). It is complex because teachers not only need to know *what* to teach i.e. subject knowledge or mathematical content knowledge, they also need to know *how* to teach this content. Sowder (2007) describes the knowledge needed for teaching mathematics as “a blend of subject knowledge and an understanding of how to deliver this” (p. 173). This is consistent with Shulman and Grossman's definitions of pedagogical content knowledge and they conclude that teachers' knowledge needs not only subject matter but also knowledge of how to teach this subject matter. The challenge for ITE programmes is to provide learning opportunities for pre-service teachers to develop pedagogical content knowledge for teaching mathematics, i.e. both mathematical content knowledge and pedagogical practices for teaching

mathematics. Grossman (1990) describes this challenge as deciding what counts as knowledge and how best to teach this knowledge.

The ITE programme at the University of Canterbury provides both course work and practicum (Professional Practice) experiences as sources of knowledge for teaching mathematics. Another source is the mathematical content knowledge and notions about how to teach this knowledge that pre-service teachers bring with them into the programme. Shulman (1986) describes this as their “intellectual biography”. He defines this as “the set of understandings and conceptions and orientations that constitutes the sources of their comprehension of the subjects they teach” (p. 202). Both the course work and the professional practice experiences build on the “intellectual biography” of pre-service teachers by providing opportunities for them to learn about both the theory and practice of teaching mathematics. The challenge for them is to construct knowledge for teaching by integrating knowledge learned from each source (Ball, 2000). She describes this process as pre-service teachers having to ‘bridge the gap’ between theory and practice, course work and practicum experiences.

Fennema and Franke (1992) agree that this is a challenge for pre-service teachers as they learn to teach mathematics. They describe the learning process as a “transformation” of knowledge for teaching:

The transforming of knowledge in action is complex. Little research is available that explains the relationship between the components of knowledge as new knowledge develops in teaching, nor is information available regarding the parameters of knowledge being transformed through teacher implementation (p. 163).

While there is considerable research available about the knowledge needed for teaching mathematics and how teachers acquire this knowledge, there is limited research from the point of view of the pre-service teacher. Pre-service teachers who are learning about teaching in an ITE programme are positioned differently to teachers situated in a school setting. They are constrained by the experiences of the ITE programme and do not have the benefit of prolonged experiences in the classroom to draw on, when constructing their knowledge about teaching. Borko and Putnam (2000) highlight that “unlike experienced teachers, however, pre-service teachers do not have their own classrooms in which to situate learning experiences



and have limited teaching experiences from which to draw in discussions about teaching.” (p. 7). Shulman (2004) describes the knowledge teachers have about teaching as originating from ‘the wisdom of practice’. Pre-service teachers differ from teachers in that their ‘wisdom of practice’ is just beginning to develop. Within the context of their ITE programme, pre-service teachers can experience fragmented and discrete practical experiences. A challenge is to integrate theory and practice, and also to integrate knowledge gained between practices.

In addition to this, Ensor (2001) suggests another challenge for pre-service teachers is transitioning their knowledge from the ITE programme setting to future school settings. She refers to this as “recontextualising” knowledge for teaching, suggesting pre-service teachers “recontextualise” their knowledge by disembedding, re-embedding and changing knowledge for teaching from one setting to the next. This study aims to not only investigate the knowledge needed for teaching mathematics but also aims to identify what pre-service teachers know about teaching mathematics, how they know it, and how they prepare to transition or “recontextualise” this as they anticipate teaching mathematics in their first year of teaching.

## ***The Study***

The pre-service teachers, who were the focus of this study, were in their third and final year of their ITE programme during 2008. The specific context for the study was the mathematics course; EDMS372 entitled *Implementing Mathematical Programmes in the Primary School*. EDMS372, (hereafter referred to as the mathematics education course), is an optional course, which means the pre-service teachers have chosen it from a selection of curriculum courses. The course content is designed to teach current pedagogical practices for teaching mathematics in New Zealand. Specific course content is:

- the mathematics and statistics learning area of *The New Zealand Curriculum* (2007a);
- classroom organisation and grouping;
- long-term and unit planning;
- assessment practices;
- evaluation and selection of resources.

A feature of the 2008 mathematics education course was the introduction of *The New Zealand Curriculum* (Ministry of Education, 2007a), released in 2007 and mandated

to be implemented in schools by 2010. This course provided the first opportunity for the pre-service teachers to learn about the new curriculum. During the first two years of their ITE programme in mathematics education, they had learned about and used the 1992 mathematics curriculum, *Mathematics in the New Zealand Curriculum*. In this study, the 1992 curriculum document will be referred to as the *old* document, while the 2007 curriculum document will be referred to as the *new* document.

I am the course co-ordinator and lecturer for this course and have taught variations of this course over the last eight years. As the co-ordinator, I have responsibility for the design, teaching and assessment of the course content. While the course content is reasonably fixed, (I am required as the lecturer to teach to the learning outcomes of the course), I have the flexibility to teach content to meet the needs of the students. I try not to make assumptions about these needs and therefore have built in opportunities to determine these needs within the course structure. Over time, I have become aware that the course is popular and successful, but have had limited opportunities to delve into the reasons for this. This study provides an opportunity to do this, by formalising this process and providing the pre-service teachers an opportunity to ‘voice’ their needs in relation to what knowledge they need to teach mathematics and how they develop this knowledge during the course.

The course content is organised and taught according to constructivist views of learning. Brooks and Grennon-Brooks (1999) outline constructivist ideals as being where the teacher seeks and values students’ points of view, structures lessons to challenge students’ suppositions, makes the curriculum relevant, designs course content around ‘big ideas’, and carries out meaningful assessment. In order to implement these ideals the course is taught in a workshop style as opposed to being a series of lectures. Each two-hour session is characterised by discussion, debate and group learning experiences. By teaching this way, my intent is that students will build on their knowledge gained in previous courses and become more involved in the learning. Klein (2004) supports the idea of teacher education practices situating students in the process of learning so that they are able to achieve authorship or authority in their knowledge construction:

The pre-service teacher could be positioned as one who may or may not know curriculum content and pedagogical strategies, but who can find out; as one who is different from every other teacher, who has special (constituted) qualities and abilities that are dynamic and changing from day to day (p. 332).

This study is concerned with finding out about pre-service teachers' knowledge for teaching mathematics, including curriculum knowledge and pedagogical strategies for teaching mathematics, and how they construct this knowledge within the context of their ITE programme. In addition, this study seeks to establish how they are transforming this knowledge as they prepare to transition from being pre-service teachers to beginning teachers. Winsløw, Bergsten, Butlen, David, Gomez, Grevholm et al. (2009) claim that this transition is a key challenge for pre-service teachers. To assist this transition, and to maximise the course experience, I encourage the pre-service teachers during the course to "*put their teacher hats on*". This positioning may prompt them to begin to realise their future teaching responsibilities. This study seeks to understand the concerns of pre-service teachers as they face this prospect.

During 2007, I had the opportunity to pilot this study and during this time, I was able to trial and evaluate the effectiveness of some data collection methods. In the pilot study, the long-term planning task, which was a course assignment, was used as a context for data collection. This task served to elicit information from the pre-service teachers about the mathematics knowledge they needed to plan a year-long mathematical programme and the process they engaged with to complete the plan. The experience of piloting the study helped to refine and inform the research questions for this study, which are:

***Research Questions:*** *As third year students prepare for their first year teaching mathematics in a primary school:*

- 1. What are their issues as they plan a yearly programme in mathematics?*
- 2. What are their emerging needs as they anticipate developing and implementing their classroom mathematics programme?*

These questions will be used to elicit information about knowledge needed for teaching mathematics, from the pre-service teachers participating in this study.

### ***Structure of the thesis:***

**Chapter 2** presents an overview of literature related to knowledge needed for teaching, knowledge needed for teaching mathematics, and the challenges for pre-service teachers as they transition from ITE programmes to the classroom. A description of the ITE setting of this study follows, including a discussion of *The New Zealand Curriculum* (2007a). This chapter concludes by presenting a model for the development of knowledge for pre-service teachers that will be used in this study.

**Chapter 3** sets out the research methodology adopted for this study, followed by a description of the research design, including the data collection methods selected, the data analysis process and ethical considerations. **Chapter 4** begins with background information about the data and then reports the data analysis, which is organised around three themes. **Chapter 5** is a discussion of these results and includes links to literature. The sixth and final chapter concludes this thesis by presenting responses to the research questions, returns to the teacher development model presented in **Chapter 2**, and finishes with implications of this study.

## Chapter Two: Literature Review

### ***Introduction***

The focus of this study is knowledge pre-service teachers need to prepare for teaching mathematics in their first year of teaching. This chapter provides an overview of relevant literature. This includes literature related to the generic knowledge needed for teaching, and more specifically within the field of mathematics education.

Implications for Initial Teacher Education and pre-service teachers are also included.

### ***Knowledge For Teaching***

Since 1986, Shulman's work about the knowledge needed for teaching has influenced policy and practice in teacher education. From his work with teachers, he has defined and categorised different areas of knowledge that are needed for teaching. His domains or categories of knowledge for teaching are listed below:

- Content knowledge
- General pedagogical knowledge
- Curriculum knowledge
- Pedagogical content knowledge
- Knowledge of learner and their characteristics
- Knowledge of educational contexts
- Knowledge of educational ends, purposes and values and their philosophical and historic grounds (Shulman, 1987, p 8).

Shulman's work is significant because it provides a framework for others working in the field of teacher education. In the United States, Grossman (1990) refined his categories to include; general pedagogical knowledge, subject matter knowledge, pedagogical content knowledge and knowledge of context (p. 6). These categories are important because they have close alignment with the content of Initial Teacher Education programmes, whose goal is to prepare pre-service teachers for teaching in a classroom.

One of the challenges of teaching is having sufficient content knowledge and the accompanying strategies to teach that content knowledge. This is called pedagogical content knowledge in the literature. Shulman (1986) defines pedagogical content

knowledge as “going beyond knowledge of subject matter per se to the dimension of subject matter knowledge *for teaching*” (p. 9). His definition follows:

Pedagogical content knowledge includes... the most useful forms of representation of those ideas, the most powerful analogies, illustrations, examples, explanations, and demonstrations- in a word, the ways of representing and formulating the subject that make it comprehensible to others... Pedagogical content knowledge also includes an understanding of what makes the learning of specific topics easy or difficult: the conceptions and preconceptions that students of different ages and backgrounds bring with them to the learning of those most frequently taught topics and lessons (p. 9).

Shulman’s choice of the term “pedagogical content knowledge” is important as it expands on the premise that teachers need more than content knowledge of a subject to teach it successfully. This is reinforced by Grossman (1989) who defines pedagogical content knowledge as:

conceptions about what it means to teach specific subject matter, knowledge of curricular materials available in a content area, knowledge of instructional strategies for teaching particular subject matter and knowledge of students’ understanding and possible misconceptions in a subject area (p. 192).

Both Grossman (1989) and Shulman (1986) concur that subject knowledge is important, but on its own, it is not sufficient knowledge for teaching. They argue teachers also need to know how to teach this knowledge in the varying and complex settings provided by schools and learners. Taking their definitions into account, pedagogical content knowledge can be understood as *how* teachers teach the content of their subject.

Pedagogical content knowledge is relevant to this study because it represents the aim of the mathematics education course. The purpose of this course is to provide pre-service teachers with an opportunity to focus on the suggested “best practices” for mathematics teaching. Grossman (1989) describes the purpose of ITE course work as giving:

prospective teachers a perspective on what it means to teach a particular subject as well as offering specific methods, strategies and ideas for teaching a subject. The intent of subject specific courses then could be conceptualized as the opportunity for construction of pedagogical content knowledge (p192).

In essence, the mathematics education course could be described as a course designed to develop beginning teachers' pedagogical content knowledge for teaching mathematics.

### ***Knowledge For Teaching Mathematics***

In the field of mathematics education, there is substantial research that investigates the knowledge needed for teaching mathematics. Most authors agree with Shulman that the teaching of mathematics is a complex task. A key study by Ball (1993) reinforces this by highlighting several aspects of knowledge needed for teaching mathematics. Ball's research investigated issues that arose as she taught mathematics in a primary school. She articulated these issues in terms of dilemmas for teaching mathematics. These dilemmas were; representing the content, respecting children as mathematical thinkers, and creating and using the community. She states, "in mathematics teaching, figuring out powerful and effective ways to represent particular ideas implies...giving serious attention to both the mathematics and children. This is more easily said than done" (p. 378). The value of her work is that it highlights the complexity of the knowledge needed for teaching mathematics. She concludes that to teach mathematics effectively, teachers need to know the content of the mathematics they are teaching and how to teach it to the children in their setting. Ball also identifies this as "pedagogical content knowledge" for teaching mathematics.

Similarly Fennema and Franke (1992) claim that mathematics teachers need knowledge of mathematics, pedagogical knowledge and knowledge of the learner's cognitions in mathematics. While these aspects can be presented discretely, they emphasise that it is the interaction between each component, within the context of classroom teaching that results in effective mathematics teaching.

Hill et al. (2007) also agree that the teaching of mathematics is complex, describing it as being "multifaceted." They argue that:

successful mathematics teaching includes the teacher's ability to solve mathematics problems their students are expected to solve, to understand content for teaching, to understand the content from the learner's point of

view, and to craft instructions that take into account both students and the mathematics (p. 125).

Likewise the following statement from The National Council of Teachers of Mathematics (2000) confirms this complexity, “Teachers of mathematics require a broad range of knowledge in order to be effective i.e. - knowledge of content, knowledge of students as learners and knowledge of effective teaching strategies”. (page unspecified).

Further studies highlight the importance of teachers knowing about mathematical content and how learners learn mathematics. For example, in New Zealand, Higgins (1999) and Thomas (1999) argue that effective teachers of mathematics need to know the content they are teaching as well as have knowledge of the learning contexts and the characteristics of the learners with whom they are working. Thomas (1999) describes important aspects of knowledge for teaching mathematics as knowledge of mathematics, knowledge of representations, knowledge of students as learners of mathematics as well as knowledge of the curriculum. She suggests this knowledge about both mathematics and students “affects all the core teaching tasks. It shapes how they select activities and resources, how they present material in class, how they interact with students and how they assess student’s progress” (p. 6). While there are several varied yet similar assertions and descriptions about the knowledge needed for teaching mathematics, there is widespread agreement that the task of teaching mathematics is indeed complex and multifaceted.

### ***Content knowledge for teaching***

The literature about effective mathematics teaching highlights the need for teachers to have appropriate levels of mathematical content knowledge. Schwabb (1984) cited in Grossman (1990) defines content knowledge as, “knowledge of the major facts and conceptions within a field and the relationship among them” (p. 6). This is particularly important for pre-service teachers. Thomas (1999) stresses the need for pre-service teachers to grasp mathematical content knowledge, and acknowledges that in New Zealand at the pre-service level, content knowledge of students is an area of concern. She suggests that teachers with mathematical content knowledge can teach content



successfully and integrate mathematical ideas, whereas teachers who have insecurities about their content knowledge may not do this effectively.

In Australia, Wilson and Thornton (2007) found that pre-service teachers needed to have a deep and connected content knowledge of mathematics in order to be successful teachers. They found that teachers with low levels of mathematical content were not only disadvantaged by their lack of knowledge, but also felt anxious about their ability to teach mathematics in an effective manner. This concern for low levels of mathematical content knowledge has also been noted by Hawera (2004) and Tobias (1994), as a barrier to effective mathematics teaching. Likewise, others argue that it is mathematical content knowledge that contributes to a teacher's beliefs, attitudes and identities about teaching mathematics (Grootenboer, 2006; Prescott & Cavanagh, 2006; Scott, 2005; Walshaw, 2004; Zevenbergen, 2006).

While acknowledging that content knowledge is essential knowledge for teaching, Ball (1993) maintains this knowledge on its own is not sufficient for teaching. Teachers need to know how to use this knowledge in the classroom because "Teaching mathematics successfully requires more than just having the ability to do the mathematics in the curriculum" (Hill et al., 2007, p. 125). In a later article, Ball (2000) reinforces this comment by suggesting that "although some teachers have adequate content knowledge, they often do not know it in ways that help them hear students" (p. 5). Content knowledge of mathematics on its own does not ensure successful mathematics teaching.

In New Zealand, Ell (2009) illustrates this point when she explains that while content knowledge may allow teachers to solve addition problems for themselves, they also need pedagogical knowledge to allow them to teach this addition content to learners. Zevenbergen, Dole and Wright (2004) purport that content knowledge alone, cannot ensure successful teaching and learning of mathematics. Rather they argue effective mathematics teaching needs to include both content and pedagogy.

Ward and Thomas (2007) carried out research in New Zealand and examined any links between the mathematical content knowledge and pedagogical content knowledge of teachers. They found that generally teachers with low content

knowledge had lower levels of pedagogical understanding while teachers with high levels of content knowledge had higher levels of pedagogical understanding. While acknowledging these were general findings, they also cautioned that not all teachers with adequate content knowledge knew how to teach content successfully in the classroom.

### ***Sources of Knowledge for Teaching***

From his early work, Shulman (1986) proposed that teachers gain their knowledge for teaching from four sources; scholarship in content disciplines, educational materials and structures, formal educational scholarship and the wisdom of practice. In a similar way, Grossman (1990) suggested that teachers develop pedagogical content knowledge from: an apprenticeship of observation (cited from Lortie (1975)), disciplinary knowledge (subject matter knowledge), professional education (coursework) and classroom teaching experience (p. 10). Such sources of knowledge are relevant to this study because they highlight important experiences that could be included in an Initial Teacher Education programme to assist pre-service teachers to develop their knowledge for teaching. In addition, Sowder (2007) suggests four professional learning opportunities teachers need in order to acquire knowledge for teaching. These are; acquiring knowledge about the learner, knowledge of the curriculum, knowledge of classroom activities and artefacts, and knowledge gained from formal coursework (p. 173). Each of these sources or opportunities contributes to the development of knowledge for teaching. It is the combination of knowledge derived from these different sources that contributes to the development of pedagogical content knowledge for teaching.

Initial Teacher Education Programmes are the main source for developing knowledge for teaching for pre-service teachers. Grossman (1990) suggests that the challenge for these teacher educators is to determine what counts as knowledge for teaching, and decide how best to teach this to their pre-service teachers. The typical components of Initial Teacher Education Programmes; subject knowledge and pedagogical knowledge, are often taught in isolation from each other. This can result in the formation of fragmented and separated knowledge for teaching, as Ball (2000) indicates by saying:

the prevalent conceptualization and organization of teachers' learning tends to fragment practice and leave to individual teachers the challenge of integrating subject matter knowledge, and pedagogy in the context of their work. We assume it's easy, but it's not (p. 4).

Therefore the challenge for Initial Teacher Educators is to integrate the different aspects together, to help pre-service teachers understand the connections between the aspects of knowledge for teaching, by "bridging the gap" between theory and practice and vice versa.

While several authors agree that Initial Teacher Education Programmes need to include experiences to develop pedagogical, content and practical understandings about teaching, it is the connections between these experiences that result in the development of knowledge for teaching (Grossman, 1989; Shulman, 1986; Sowder, 2007; Thomas, 1999). Liljedahl, Durand-Guerrier, Winsløw, Bloch, Huckstep, Rowland et al. (2009), summarise the intent of Initial Teacher Education programmes in Canada as being concerned with developing proficiency in mathematical content knowledge, pedagogy and didactics (pedagogical content knowledge). They suggest that while these dimensions of teacher knowledge are typically presented discretely within programmes, they need to be integrated or unified together to create knowledge for teaching.

Teacher educators must support pre-service teachers to see the connections between programme components i.e. between course work and practical experiences in schools. This is particularly important as each component may produce conflicting messages about teaching (Goos, Arvola, Bednarz, DeBlois, Maheux, Morselli et al., 2009). They state that, "a challenge for teacher education is to understand how pre-service teachers learn from experiences in multiple contexts - especially when their own schooling, the university methods course and their practicum experiences can produce conflicting images of teaching" (p. 83). In New Zealand, Thomas (1999) agrees that teacher educators need to help pre-service teachers see the connections between the different aspects of their programme in order to develop their knowledge for teaching.

### ***Transitioning from Initial Teacher Education – the challenge for pre-service students.***

While several researchers have been concerned with defining and describing the knowledge required for teaching, Danish researchers Winsløw et al. (2009) propose that a major challenge for pre-service teachers is the transitioning of their knowledge for teaching from Initial Teacher Education programmes to the context of their first year of teaching. They describe this transition happening at three different “levels”:

- An epistemological level i.e. academic forms of knowledge;
- An institutional level i.e. passing from one context to another;
- A personal level i.e. changing from being in a community of students to being in a community of teachers (p. 93).

The challenge at the epistemological level for pre-service teachers is to adapt the knowledge they have acquired in initial teacher education to the conditions and requirements of teaching. This can be particularly challenging if knowledge for teaching is presented in academic and separated forms in initial teacher education programmes. The challenge for teachers in their first year of teaching is to connect and implement their knowledge, gained from their courses, on a daily basis in the classroom.

At an institutional level, the challenge for pre-service teachers is to adapt from working within the institution of a university setting to that of a school setting. This involves understanding the different norms and cultures unique to each setting. To assist this transition, pre-service institutions need to provide learning experiences which best prepare pre-service teachers for the reality of the classroom. This includes evaluating modes of organising teaching for learning e.g. lectures, seminars, group work to establish if these are effective ways for pre-service teachers to develop the skills and knowledge required to be an effective teacher of mathematics. Once in the classroom, beginning teachers need the support of ongoing professional development programmes to help them make the transition from one institution to the other, particularly where they have experienced university/lecture style ways of learning, which is in stark contrast to the reality of working on a classroom.

At a personal level, the challenge for pre-service teachers is to transition from working in a community of students to working as a professional in a community of teachers. Where students may be used to working collaboratively in a university setting this cannot be guaranteed in a school setting. While beginning teachers may enjoy the sense of independence which comes from having their own class, this independence may well lead to feelings of isolation. In order to continue to develop their knowledge for teaching, beginning teachers need opportunities to interact and learn from others in their schools.

Ensor (2001) carried out a two-year longitudinal study in South Africa which looked at how secondary teachers of mathematics “recontextualised” their experiences of teaching mathematics from their methods course in their Initial Teacher Education programme to their first year teaching. She acknowledges the influence of Bernstein and Dowling in the use of the term “recontextualising” (Bernstein, 1977, 1990, 1996; Dowling, 1996, 1998 cited in Ensor, 2001). In her study, the term “recontextualising” is used to describe the process which beginning teachers followed to transition the knowledge gained from their teacher education courses to the context of the classroom. She calls this a “study of passage” (p. 297). This involves teachers disembedding, re-embedding and changing knowledge for teaching from one setting to the next. Disembedding refers to the process of taking knowledge from teacher education courses in preparation for teaching. Re-embedding refers to the process of implementing this information in the classroom, and changing refers to the process of making changes to this knowledge for the reality of each unique classroom setting (p. 297).

She describes the content of Initial Teacher Education programmes as being “privileged repertoire” for teaching, again citing the work of Bernstein (1996). She defines “privileged repertoire” as:

the set of symbolic and material resources that teacher educators (and teachers) select and configure in order to shape their classroom practice. In the case of teacher education, such a repertoire is referred to as privileged because it places in the foreground a particular selection of pedagogical resources to facilitate this, and the arrangements of these tasks into sequences as lessons. A privileged repertoire also includes features of classroom arrangements, the

regulation of teacher- pupil communication and deployment of appropriate forms of assessment (p. 300.)

The content of Initial Teacher Education Programmes is privileged because it has been selected as representing “best practice” for teaching and therefore is included in a teacher education course. Recontextualising of this repertoire for teaching occurs when pre-service teachers have the opportunity to access this “best practice” and then they have opportunities to implement this practice in their classrooms. This typically happens at pre-service level during course work and practicum experiences.

In order to learn about “best practice” for teaching, Ensor suggests that pre-service teachers need access to both “recognition and realisation rules”. Recognition rules refer to the aspects of best practice that are presented and discussed in the “privileged repertoire” adopted by a course, while realization rules refer to the implementation of this privileged repertoire in the classroom. She states:

access to recognition rules enables student teachers to describe and evaluate “best practice” discursively by means of professional argot of potentially varying degrees of specialisation. Access to realization rules enables teachers to implement best practice in mathematics classrooms” (p. 315).

An example of a “recognition rule” is when pre-service students learn in a methods course about the use of visualisation as a mathematical tool for learning, while the “realisation rule” for this would be to teach visualisation in the classroom (p. 314). Both recognition and realisation are needed for learning to occur for pre-service students. In the absence of either experience, there could be ambiguity about the value of this piece of repertoire for teaching. Ensor proposes that it is easier for Initial Teacher Education programmes to provide access to recognition rules via methods courses, while it is challenging, yet essential to provide realisation experiences in the classroom.

In Initial Teacher Education programmes, access to realisation rules for pre-service teachers is typically carried out during practicum experiences in schools. It can be difficult, however, for pre-service teachers to receive adequate supervision and feedback during these experiences, particularly when pre-service teachers are visited on professional practice by lecturers who are not their methods course lecturers. When this occurs, opportunities to maximise learning by connecting recognition and

realisation rules in the classroom can be compromised. A challenge for Initial Teacher Education programmes is to present and connect both experiences so that pre-service students can develop their repertoire for teaching.

While the challenge for pre-service students has been described as “transitioning” or “recontextualising” their knowledge for teaching, Fennema and Franke (1992) describes it as “transforming” (p. 162). They support the notion that knowledge for teaching develops through the actual act of teaching. They suggest the challenge all teachers face, is to take the knowledge they have learnt about teaching and *transform* it for use in the classroom. This transformation must ultimately result in student learning. The challenge for teacher educators then is to create learning experiences that are powerful enough to transform teaching for classroom practice (Borko and Putman, 2000; Fennema and Franke, 1992). A situative perspective about learning suggests that knowledge is developed by being situated in different contexts - “knowing and learning are situated in physical and social contexts, social in nature and distributed across person and tool” (Borko & Putman, 2000, p. 12). These social contexts for pre-service students typically involve course work and fieldwork i.e. teaching practice experiences. For learning to be effective, pre-service students need opportunities to connect their learning that occurs in both contexts. Viewed on its own, each context has limited benefit for learning about teaching, but can be:

carefully combined with university course experiences to provide coordinated opportunities for pre-service teachers to learn new ideas and practices, as well as reflect and receive feedback. Thoughtfully combining university and field - based experiences can lead to learning that can be difficult to accomplish in either setting (Borko & Putman, 2000, p. 7).

The challenge therefore for teacher educators is to help pre-service students transform their learning from different contexts both within their Initial Teacher Education programmes and from these programmes into their first year of teaching.

Thomas (1999) recommends that future research needs to explore effective ways of supporting beginning teachers as they make the transitions from their teacher education programmes to the classroom. She acknowledges that almost all teachers experience the transition from training to teaching as the most difficult aspect of their career, involving feelings of fear, anxiety and isolation. How well students pass

through this period is strongly related to how likely they are to reach higher levels of professional competence. In a New Zealand study Lang (2001) interviewed beginning teachers about their needs in their first year of teaching, and asked them about aspects that in hindsight, they would have liked to have had included in their pre-service programme. Each participant responded differently. Areas identified by the respondents were curriculum understanding, more practical teaching experience, mathematics planning - both long term and unit planning, grouping children for mathematics instruction, and generally how to “run their mathematics programme” (p. 94). Based on these and other responses in her study, Lang found that pre-service teachers had varying perceptions as to the value of their pre-service programmes, suggesting that some did not see the relevance of programme components for future classroom teaching. She also suggests that some beginning teachers lost sight of the fact that their first two years of teaching were a continuation of their pre-service learning. For this reason professional development programmes, with the allocation of tutor teachers, need to be provided by schools. She acknowledges that while the responses of the respondents in her study varied, that each of these voices is significant: “What they say can inform our understanding of what is needed in the design of high quality teacher education programmes, with all the attendant fears, stresses and successes” (p. 96). My study develops this knowledge by identifying the needs of pre-service students as they complete their Initial Teacher Education programme and make the transition into their first appointment.

### ***Initial Teacher Education***

This next section provides an overview of Initial Teacher Education in New Zealand at the national level, the institutional level and finally describes the mathematics education curriculum course that is the setting of this study.

Lang (2001) claims there are different stages when learning to teach. In a review of Initial Teacher Education policy in New Zealand (Ministry of Education, 2007b), three phases in the journey of becoming a teacher were identified. These were:

- Phase 1 Initial Teacher Education, including practicum experience;
- Phase 2 In-service induction of a provisionally registered teacher; and
- Phase 3 Fully registered teacher career (p. 8).



The review states that as student teachers become new teachers, i.e. as they transition from Phase 1 to Phase 2, it is expected that they will have:

- a secure grasp of general pedagogical skills such as task design, assessment and evaluation;
- the knowledge to build positive relationships with diverse learners; and
- an in-depth understanding of the content and objectives of the curriculum they will be expected to teach (p. 20).

In New Zealand, Phase 1 of the learning to teach journey occurs within an Initial Teacher Education Programme, provided by a University or other provider.

A report on Initial Teacher Education in New Zealand (Kane, 2005) aimed to distinguish the characteristics of New Zealand teacher education qualifications and identified the processes, which ensured quality implementation of these processes. Like other teacher education literature, the report recognised that beginning teachers' preparation was a complex and multifaceted task. It recommended that Initial Teacher Education in New Zealand needed to provide qualifications that were built upon strong visions of good teaching practice. This needed to be supported by sound theoretical informants and relevant research on the design of teacher education programmes, on curriculum development within teacher education, quality teaching, how people learn, and how people learn to teach.

Winsløw et al. (2009) indicate that one of the major goals of research in maths education is to make teacher education align with professional competence paradigms for what it means to be a mathematics teacher in a school. In New Zealand, this intent is realised in the *Graduating Teacher Standards* (Teacher Registration Board, 2007). This document from The New Zealand Teachers Council, states what a teacher (at the point of graduation from an Initial Teacher Education programme) will know, understand, be able to do, and the dispositions they will have ([www.teacherscouncil.govt.nz](http://www.teacherscouncil.govt.nz)). The document includes seven standards which are organised into three major categories; professional knowledge, professional practice, professional values and relationships. Two of these standards are of particular relevance for my study, namely:

### Professional Knowledge - Standard One:

Graduating teachers know what to teach:

- a. have content knowledge appropriate to the learners and learning areas of their programme
- b. have pedagogical content knowledge of learners and learning areas of their programme
- c. have knowledge of curriculum documents of Aotearoa New Zealand

### Professional Practice - Standard Four:

Graduating teachers use professional knowledge to plan for a safe, high quality teaching and learning environment:

- a. draw upon content knowledge and pedagogical content knowledge when planning, teaching and evaluating.”
- b. use and sequence a range of learning experiences to influence and promote learner achievement.
- c. demonstrate high expectations of all learners, focus on learning and recognise and value diversity.
- d. demonstrate proficiency in oral and written language (Maori and English) in numeracy and in ICT relevant to their professional role (www.teachers.council.co.nz).

Both the Initial Teacher Education Review and the Graduating Teacher Standards take cognisance of the literature about the knowledge needed for teaching, previously discussed in this chapter, particularly the work of Shulman and Grossman. Standard one highlights content knowledge, pedagogical content knowledge and knowledge of the curriculum as being essential knowledge for teaching as pre-service students transition from Phase 1 to Phase 2. The challenge for Initial Teacher Education providers in New Zealand is to decide how best to provide programmes that meet these requirements. Each University programme is developed separately and is approved by the New Zealand Teachers Council. In the next section I introduce the degree programme for Initial Teacher Education at the University of Canterbury.

### ***The University of Canterbury - The Bachelor of Teaching and Learning***

The teacher education programme which forms the context for my study of a mathematics course requires the successful completion of three years of study. At the time of writing, this degree is in the process of being reviewed. The last review in 2005 included a conceptual framework, which provided underlying principles to support the teaching of the courses within the degree. These underlying principles outline the knowledge base required for teaching within the degree course and were

informed by the work of Shulman (1987) and Grossman (1990). The mathematics education course is situated within this degree. This course is offered as an optional course for third year students. The content of the course includes; The New Zealand Mathematics curriculum documents, classroom organisation and grouping, long-term and unit planning, assessment, and resource selection.

### ***The New Zealand Curriculum***

The graduating teacher standards identify curriculum knowledge as being crucial knowledge for pre-service students to have at the end of their Initial Teacher Education programme. This is consistent with Shulman's and Grossman's areas of knowledge needed for teaching. Shulman (1986) describes curriculum knowledge as:

The full range of programmes designed for the teaching of particular subjects and topics at a given level, the variety of instructional materials available in relation to those programmes, and the set of characteristics that serve as both the indication and contraindication for the use of particular curriculum or programme materials in particular circumstances (p. 10).

He views teacher's knowledge of the curriculum as being more than understanding the content of the subject they are teaching. Teachers need to know the content of the curriculum subject, have knowledge and understanding of how this curriculum content is developed for teaching and how each curriculum subject relates to other curriculum subjects:

The curriculum and its associated materials are the *material medica* of pedagogy, the pharmacopeia from which the teacher draws those tools of teaching that present or exemplify particular content and remediate or evaluate the adequacy of student accomplishments" (p. 10).

At the time of this study, *The New Zealand Curriculum* (Ministry of Education, 2007a) had been introduced for use in New Zealand schools. There were several changes made to this curriculum from previous documents. The changes that are relevant to this study are the formation of one curriculum from several subject-based curriculums. This means that where previously there was a separate mathematics curriculum document, mathematics is now included as a section or "learning area" in the 2007 curriculum.

In addition, generic pedagogical approaches for teaching are included, and organisation and content of the achievement objectives for teaching mathematics have been changed.

Key changes in the mathematics area include; renaming “mathematics” as “mathematics and statistics” and compressing the previous five mathematical strands for teaching into three i.e. Number and Algebra, Geometry and Measurement, and Statistics. The justification for this is to simplify the structure of the statements in the curriculum for these strands, and to highlight key connections between the strands in the previous curriculum document. The number of achievement objectives for each strand has been reduced from the previous document and has been written in more general terms. This has been in response to feedback, which suggested that the curriculum was overcrowded and needed significant simplification and integration. A new feature is the addition of Venn diagrams at each level of the curriculum to suggest the ratio of instructional time that should be devoted to teaching each strand (Wright, 2007).

McGee (2008) suggests that choosing curriculum content is both controversial and difficult and writes:

In spite of the fact that the selection of content is never universally agreed, the national curriculum document *The New Zealand Curriculum* (2007) contains core knowledge considered suitable and desirable – by the designers – for all students to learn in schools (p. 65).

In his evaluation of the 2007 curriculum, Barker (2008) agrees, noting that the changes that have been made highlight the debate about *what* and *how* much prescription should or could be included in a curriculum. He questions whether the revision of the content of the achievement objective will enhance teachers’ understandings of the objectives and the ways in which they interconnect with each other to form a broader picture of knowledge. He also acknowledges the inclusion of pedagogical approaches to teaching. He suggests that the term “pedagogy” is often used as a synonym for “teaching” citing Winch and Gingell (1999) who define pedagogy as “a method of teaching interpreted in its wider sense”( p.170). He questions the implications of the inclusion of pedagogical approaches in the

curriculum, and suggests that Initial Teacher Educators need to look at the limitations and liberations implied by the inclusion of these approaches in the curriculum (p. 15). The challenge for Initial Teacher Education teachers is to look at how best to develop pre-service teachers' understandings of the curriculum changes within their current course structures.

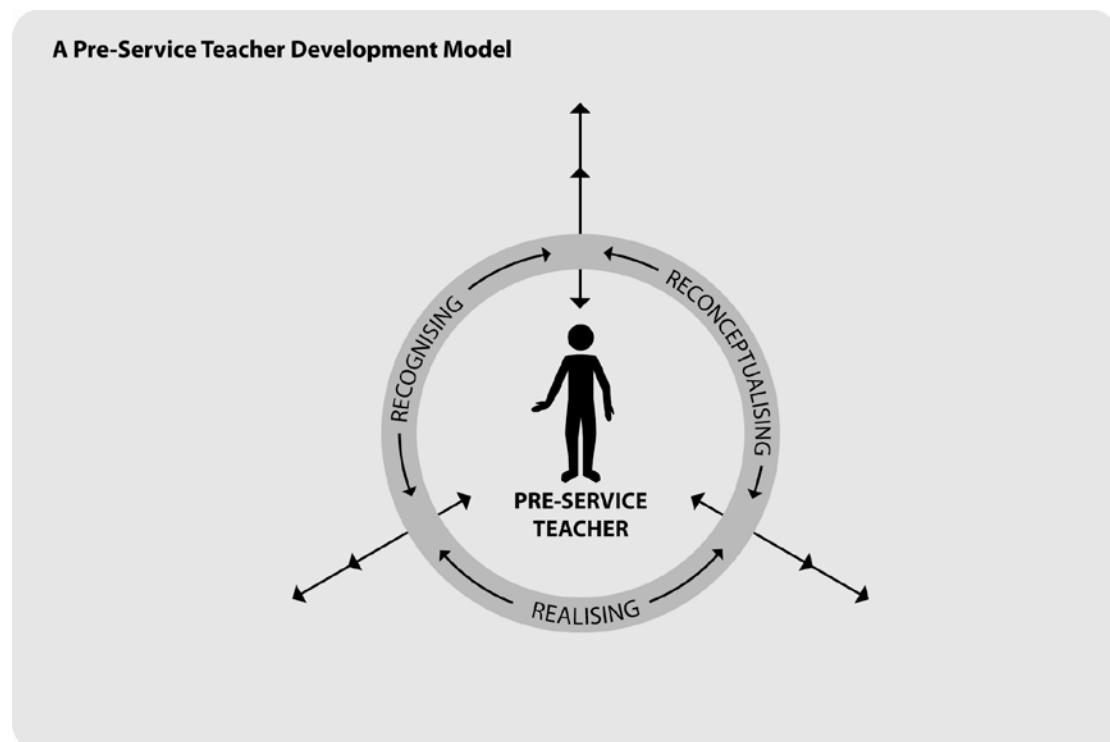
### ***Aims of this Study***

The mathematics education course sets out to do this by focussing on the curriculum and pedagogical approaches for teaching mathematics as implied by the new curriculum document. Using this course as the context for this study, allows for the investigation of pre-service teachers' understandings of both the content and the pedagogy required to teach mathematics.

The knowledge needed for teaching, the knowledge needed for teaching mathematics and the process of transforming this for teaching from within and beyond pre-service programmes are central premises for this study. Having considered the extensive literature around this topic, and the variation in definitions of this knowledge, (particularly pedagogical content knowledge) I have decided to define pedagogical content knowledge as 'best practice' for teaching mathematics in the primary school.

In this study the sources of knowledge for teaching are; the knowledge that pre-service teachers bring with them as they begin the Bachelor of Teaching and Learning degree, referred to as their 'intellectual biography', (Shulman,1986), course work and Professional Practice experiences.

While the aim of the research questions is to ask "what" knowledge is important for mathematics teaching, this study also seeks to define "how" this knowledge is developed. Having considered relevant literature, I developed the following model for this study. This model, based on the work of Ensor (2001), Bernstein ((1990) cited in Ensor, 2001), and Winsløw et al. (2009), proposes three parts to the process pre-service teachers engage with, as they develop their knowledge for teaching. These are i.e. *recognising*, *reconceptualising* and *realising*. This is illustrated in the following model:



**Figure 2.1 A Pre-service Teacher Development Model**

The pre-service teacher is at the centre of the diagram. As they progress through the their pre-service programme and are exposed to different sources of knowledge, they engage in a process of recognising, reconceptualising and realising different, yet integrated areas of knowledge for teaching. Each part of this process is defined below:

***Recognising:*** refers to the aspects of knowledge for teaching that pre-service teachers recognise as they experience their ITE course. In this study, recognition means to notice, identify and acknowledge “best practice” i.e. pedagogical content knowledge for teaching mathematics from the various sources of knowledge for teaching.

***Reconceptualising:*** refers to the way in which pre-service teachers generate new knowledge as they attempt to make sense of and understand their recognitions. This acknowledges a constructivist view of learning where new learning is connected to existing knowledge, to form new knowledge (Mayers & Britt, 1995). A constructivist paradigm positions the learner at the centre of the learning process, as depicted in the pre-service teacher development model.

***Realising:*** refers to the process in which pre-service teachers realise or “make real” new knowledge for use in the classroom. This includes the actual implementation of knowledge in practice, which typically occurs for pre-service teachers during Professional Practice experiences. It also includes intended implementation of knowledge for future classrooms.

This study proposes to use this model to investigate how pre-service teachers develop their knowledge for teaching mathematics as they engage with the mathematics course.

In this chapter I have reviewed the literature related to the knowledge needed for teaching, with a focus on the teaching of mathematics. I have also outlined the ITE context and have proposed a Pre-service Development Model for use in this study. The next chapter describes the methodology and research design of this study.

## Chapter 3: Methodology and Methods

This chapter describes the methodology and research design of this study. This includes a description of the data collection methods, ethical considerations, and the data analysis process. The chapter concludes with a description of three important themes that emerged from the data.

### ***Methodology***

The main purpose of this study is to gain information from pre-service teachers about the issues they are facing as they prepare to implement a mathematics programme in their first year teaching in a primary school. The study is concerned with examining and interpreting their unique perspectives as they experienced the mathematics education course. For this reason, I selected a methodology which adheres to an interpretive research principles. Neumann (2000) defines this approach as being:

the systematic analysis of socially meaningful action through the direct detailed observation of people in natural settings in order to arrive at understandings and interpretations of how people create and maintain their social world (p. 68).

Cohen, Manion and Morrison (2000) elaborate on this definition by describing the interpretive paradigm as being concerned with the individual, understanding the subjective world of human experience, while retaining the integrity of the phenomena being investigated. The research begins “with individuals and sets out to understand their interpretations of the world around them” (p. 23). In this study, the “people” are the pre-service teachers, and the “natural setting” is the ITE mathematics education course.

The setting for this study is significant as it enabled the research to be carried out in the authentic context of the course. At the time of this study, the pre-service teachers were immersed in the process of learning about *what* to teach and *how* to teach mathematics in the classroom. The research questions were designed to draw on the knowledge they were gaining about teaching mathematics, as they experienced the course.



The timing of this study is also important, because the pre-service teachers are preparing to make the transition from their ITE programme to their first year of teaching. Denzin (2002) suggests that interpretive approaches to research are useful because they are concerned with examining turning-point experiences. The transition from pre-service teacher to beginning teacher is a critical “turning point” for the participants in this study. Furthermore Denzin (2002) suggests that interpretive approaches allow the researcher to determine how individuals interact with experiences, and how they organise, perceive and construct meaning from them. The aim of this study is to find out about the experiences of participants as they interact with different sources of knowledge about mathematics teaching; in other words, how they perceive and construct meaning from these experiences. Therefore, an interpretive approach is appropriate for this study.

A qualitative approach to research was adopted for this study, because it aligns with an interpretive paradigm. Qualitative approaches allow the researcher to work with a small number of people, interpret experiences within contexts, and generate theory by following inductive principles. In addition, qualitative approaches allow the researcher to celebrate diversity and difference, and value personal involvement and partiality (Davidson & Tolich, 1999). These principles match the intent of this study, because it aims to elicit information about mathematics teaching from the perspective of the pre-service teachers. Lang’s (2001) study emphasised the importance of giving teachers a *voice*, because:

What they say can inform our understanding of what is needed in the design of high quality teacher education programmes and what it means to try and put into practice what is learned in such programmes - with all the attendant fears, stresses and successes (p. 96).

While this study differs to Lang’s both are interested in placing the participants (i.e. pre-service teachers) at the centre of the research so their voices can be heard.

## ***Research Design***

### **Research context**

The context for this study was the mathematics education course, which was taught over a five-week period in April and May of 2008. There were nineteen students

enrolled in the course, with pre-service teachers attending three two-hour lectures per week over the five-week period. The pre-service teachers enrolled in this course had completed two years of compulsory mathematics education courses within the Bachelor of Teaching and Learning degree at the University of Canterbury. They had selected this course from a number of different third year optional curriculum courses. This course was placed between their two professional practices for the year and was their penultimate mathematics course for the year. They still had to complete their final compulsory mathematics education course later in the year.

### **Data collection methods**

The two main data collection methods for this study were questionnaires and focus group interviews. These were selected because they are consistent with qualitative research methods and considered to be the most appropriate and efficient way to gather information for this study. Both methods were successfully trialled in 2007 during the pilot study, and were adapted for use in this study.

### **Questionnaires**

Two questionnaires were used in the study. Both questionnaires were an existing feature of the mathematics course and were administered during course sessions. There were several advantages to using questionnaires. One advantage was that they allowed data to be gathered from individual participants while avoiding direct contact with the researcher. Participants could therefore respond individually and privately and ensured the confidentiality of their responses. An advantage of using questionnaires is that they can guarantee confidentiality and can elicit more truthful responses than could have been obtained by using other methods (Burns, 1997). Avoiding personal contact with the researcher is often more comfortable for respondents.

Another advantage of carrying out the questionnaires was that they could be completed during course sessions, which was an efficient use of time. This also meant participants were able to record information while they were positioned in the context of the course, avoiding time delays and gaps in recall of experiences. Mutch (2005) suggests it is important to avoid having time delays in the recall of experiences. Using questionnaires meant responses were immediately recorded following course

experiences, and were an efficient way to gather data during the short time frame of the course.

Questionnaires allow for consistency in their design, and provide a standardised format for participants. While consistency of interpretation of the questions cannot be guaranteed, they all received the same format (Burns, 1997). The questionnaires were semi-structured which meant that students were asked to provide written responses to open-ended questions. Cohen et al (2000) describe the purpose of a semi- structured questionnaire as, “setting an agenda while not presupposing the nature of the responses” (p. 248). This study is aimed at eliciting information from the students’ point of view so it was important that the methods selected provided them opportunities to do this. Cohen et al (2000) summarise the benefits of using questionnaires as; allowing for anonymity, encouraging honesty, and allowing for efficient uses of time. All three of these reasons are applicable to this study.

While questionnaires have many advantages, they also have limitations. One limitation is that the written information recorded by participants could be interpreted in different ways. The written format of a questionnaire does not allow for the clarification, explanation or elaboration of responses. Burns (1997) suggests that responses to questionnaires can be ambiguous or incomplete and that they are unsuitable where probing for information is desirable. Taking this into account, I decided to carry out a series of focus group interviews as an additional data collection method, to allow for an opportunity for open-ended discussions.

## **Focus Group Interviewing**

Davidson and Tolich (1999) describe focus group interviewing as a powerful technique for gaining an insight into the opinions, beliefs and values of a particular group while allowing the group the freedom to discuss issues of concern (p. 231). It is for this reason that I selected focus group interviewing as a data collection method. While the questionnaires had elicited information from individual participants I needed a method that would give participants an opportunity to talk collectively. I wanted to give participants an opportunity to discuss new information relating to the

research questions as well as to add to and elaborate on information already provided in the questionnaires.

I saw focus group interviewing as an opportunity for participants to be involved in a process that encouraged them to articulate their views. Bogden and Biklen (2007) suggest that the group process is beneficial in stimulating discussion while also helping participants to realize their own views as they become involved in the discussions. Cohen et al. (2000) also suggest that the interactive process allows the views of the participants to emerge. This has the benefit of enabling their agenda to emerge as opposed to that of the researcher. This was important in the context of this study as I wanted the data to be generated from the participants.

From my perspective as the researcher, the face-to-face nature of the group interviewing situation allowed me to develop my relationship with the participants by continuing to build rapport with them throughout the interviewing process. Burns (1997) suggests that this is advantageous, as the participants can feel more motivated to respond. Neumann (2000) describes this as empowering participants, thus encouraging them to contribute to the discussions. By maintaining a positive relationship with them, both as the course lecturer and the researcher, I hoped to maximise the opportunities for data collection.

Another advantage of focus group interviews is that they allowed me to follow a semi-structured design. Burns (1997) describes the following benefits of semi-structured interviews:

Rather than having a specific interview schedule or none at all, an interview guide may be developed for some parts of the study in which without fixed wording or fixed ordering of questions, a direction is given to the interview so that the content focuses on the crucial issues of the study. This permits greater flexibility than the close - ended type and permits a more valid response from the informants' perception of reality (p. 330).

For this study an interview guide was based on open-ended questions. These were used as a framework for the focus group interviews. Mutch (2005) describes an open question as “one which allows the respondent to state their responses in their own way” (p. 120) .While it was important to have a framework in place I did not want to

limit the responses in the interviews by only asking established pre-set questions. I was aware that open-ended interview questions can often prompt participants to go in different directions that as the researcher I may not have considered (Anderson, Herr & Nihmen, 2007).

This method also has the benefit of allowing me to be flexible in my responses to the participants. I was able to ensure that the questions asked in the interview were clear, as I could repeat and rephrase questions for participants where necessary. The interview situation also enabled me to probe participants for more information if I felt it was necessary to extend or clarify their contributions (Burns, 1997). This was particularly important where there was information in the questionnaires that needed to be followed up. Cohen et al. (2000) suggest that a key purpose of interviewing is that it allows the researcher an opportunity to triangulate data and to collect deeper information about elements that have already been uncovered using other methods.

I also selected focus group interviewing because it was a method that was efficient of time. I was able to interview in a group situation as opposed to interviewing individuals (Mutch, 2005). An advantage of this method is that it produces considerable and often complex information in a short space of time (Davidson & Tolich, 1999). This was important to consider due to the limited time frame I had for this study.

While this method has many advantages, I also needed to be mindful of its limitations. The key limitation for this study was that while a focus group interview requires participants to contribute discussions in a public arena, they may not always feel comfortable to share important experiences in this group setting. Because of this quality data may be omitted in this setting (Bogden & Biklen, 2007). Knowing this, it was important to provide opportunities for participants to contribute information privately, via the questionnaires, and publically, via the group interviews. While not necessarily a limitation, the logistics of carrying out the interviews had to also be carefully considered. Several authors, Bogden and Biklen (2007) and Cohen et al (2000), discuss the importance of making decisions about how many interviews to hold given the time constraints of the study, the size of the groups for each interview taking into account unknown attrition rates, and the need to have a suitable interview

location for the participants. Cohen et al. (2000) suggest that when deciding on the number of participants for each interview it is advantageous to over-recruit participants. This is to cater for “no shows” i.e. participants who do not turn up. This is advice I followed in this study and which turned out to be a prudent decision. Neuman (2006) cautions that due to time restraints, focus group interviewing can limit the number of topics that can be discussed in any one session. To counter this I decided to carry out two separate interviews which were designed to focus on the two research questions.

Cohen et al. (2000) highlight the importance of the researcher being aware of the need to have the skills to facilitate the interview. A key aspect of facilitation that I needed to consider was keeping the interview open-ended while not being too directive. To do this I developed open-ended questions to act as a framework to guide each interview. I also needed to be aware of ensuring that each participant had an opportunity to speak during each interview and not allowing individual participants to dominate the discussions.

## **Questionnaires**

The two questionnaires used to collect data, were a needs assessment sheet and a long-term planning questionnaire.

**Needs assessment sheet:** This is a usual component of the mathematics education curriculum course. Each year, students enter the course having had different experiences in previous mathematics education courses and while teaching mathematics while on professional practice. As the course lecturer, it essential that I know the needs of the students because the course is designed to respond to students’ needs.

The questionnaire was administered during the first lecture of the course and was completed by all students participating in the course. However, only questionnaires completed by volunteers for the study were used as a data source. The questionnaire comprises a list of the intended lecture content for the course. Students are required to individually record their learning needs in relation to this content (Appendix A). Once

completed, the information on the sheets is used to inform the planning and teaching of the lectures within the course.

For this study, this questionnaire was an efficient way to collect individual data from the participants and provided initial information, which allowed me to start to form ideas about students' needs as they prepared to develop and implement their mathematics programmes in their first year of teaching. This questionnaire served to alert me to common themes relating to the research questions that may emerge as further data was collected.

**Long term plan questionnaire:** The second questionnaire was a questionnaire about long term planning which was also a usual component of the course. The aim of this questionnaire was to provide students with an opportunity to reflect on the process they had been through to complete the long-term plan. It provided them with an opportunity to individually record responses to open ended questions relating to this process (Appendix B). It was completed by all students in a lecture directly after they had handed in their first assignment which was the long-term planning assignment. Again, while all students completed the questionnaire, only those completed by volunteers for the study were used for data.

**The Focus Group Interviews:** Initially my intention was to carry out two sets of focus group interviews at the end of the course. I decided to have two sets of interviews so that I could manage the size of each group and so that participants could have the flexibility of choosing an interview time to suit them. During these interviews, I had planned to ask questions relating to both research questions i.e. questions about long-term planning and questions about issues and needs relating to developing and implementing a mathematics programme in a primary school. However, after the participants had completed the long-term planning assignment and the long-term planning questionnaire, it was evident that information relating to long-term planning was fresh in their minds. I decided to change the research plan and carry out one set of focus group interviews, which just focussed on long-term planning, midway through the course. I wanted to avoid a time delay and capitalise on the immediacy of the information from the participants. The participants were consulted and agreed to this change. The result was that two sets of interviews were

held midway through the course. Six participants attended the first interview while two participants attended the second interview. Each interview was audiotaped and then transcribed. An outline of the interview questions are included in Appendix D.

During these first interviews, participants were given their completed but unmarked long-term plan assignments to refer to. The intention of this was to provide participants with their own plans so that they could refer to them during the interview. I hoped that the plans would act as a prompt to assist them to recall information about the process of completing the plans. I also hoped that the plans would be used to explain and exemplify participants' thinking during the interviews. This was an important decision to make as I did not want participants to be distracted by assignment grades and lecturer feedback during the interviews. I also wanted to protect their privacy by not having their assessments of the assignments made public in the group setting. This decision was informed by the pilot study where I had made the mistake of giving participants their marked long-term plans in the group interview. In that interview, the assessments were made public and participants were distracted by their assessments, which detracted from the interview.

Two final focus group interviews were held at the end of the course. The timing of this was important because I hoped that having finished the course, the course content would act as a prompt to support participants' discussions in the interviews, in the same way that the long-term plans had supported them in the previous interviews. Seven participants attended the first interview and due to unforeseen circumstances only one participant was able to attend the second interview. In this instance I gave the sole participant the choice to carry on with the interview which she agreed to do. Two participants who were unable to attend these interviews agreed to provide responses to the interview questions by email. One participant did so providing detailed responses to each question.

**Research Journal:** Throughout the research process, I kept a research journal. The purpose of this was to have a place to document a variety of information that I deemed to be important throughout the research process. I used the journal as place to record information that I felt was relevant to the study throughout the research process. Examples of these included jottings relating to participants' questions and



comments made throughout the course. Neuman (2000) describes jotted notes as being “short temporary memory triggers such as words, phrase or drawings taken inconspicuously” (p. 364). While this journal was not intended as a main source of data, it provided a place to record incidental information that could support information generated from the other data collection methods. Creswell (2005) describes the purpose of recording these kinds of reflective notes as a way for the researcher to record hunches about important results, insights or emerging themes. I also used it to record notes about management and organisational issues relating to the research process.

### **Ethical considerations**

The main ethical consideration for this study was ensuring the safety of the participants. The university system is hierarchical in nature, which as the lecturer for the mathematics course placed me in a position of authority over the students in the course. For the duration of the course I had two roles – one as the lecturer and one as the researcher. Anderson et al. (2007) emphasise that “carefully thinking through one’s positionality within an organisation is important in understanding how it may impact the trustworthiness of the findings and the ethics of the research project” (p. 9). The key ethical consideration as a result of this relationship was related to the assessment component of the course. Participants had to complete two assignments as part of the course and in my role as lecturer it was my job to assess these assignments. I was aware that this component had the potential to affect the participants’ willingness to contribute during the data gathering process.

To manage the risk to participants the assessment components were kept separate from the data gathering process. The exception to this was when assignment one (the long-term plans) were made available for reference during the mid course focus group interviews. As explained earlier, these plans were returned to the students unmarked. This ensured each participant’s right to privacy was upheld. All participants and course members were given the option of having all their course assignments moderated by other members of staff in the primary mathematics department if they felt it was necessary. This is usual assessment practice within the course and no participants requested this.

The data collection methods for the study were selected to give participants an opportunity to respond both individually and collectively. The questionnaires were completed during class time which was an efficient use of participants' time. The focus group interviews were planned to fit in with participants' schedules and were carried out in a physical space which was familiar and which was away from the course teaching space. The purpose of each interview was explained to the participants before starting and refreshments were supplied.

At the beginning of the course, course members were asked to volunteer to participate in the project. From the outset I made it clear to all course members that their decision to participate in the study would have no bearing on their grades for the course. Volunteers were provided with detailed information about the study in the first lecture and were asked to complete consent forms confirming their willingness to participate in the study. The study had been given ethical approval by The University of Canterbury ethics committee before it commenced.

Another ethical issue related to my roles of being a lecturer and researcher. Over the five-week period I needed to ensure that I made time to carry out the responsibilities I had as course lecturer as well as timetabling research time into my work load. I had to maintain the confidentiality and anonymity of the participants and was aware of remaining objective when interviewing. Tuhiwai Smith, (1999 cited in Mutch, 2005) cautions:

Insider research has to be as ethical and respectful, as reflexive and critical, as outsider research. It also needs to be humble. It needs to be humble because the researcher belongs to the community as a member with a different set of roles and relationships, status and position (p. 86).

Throughout the process I needed to be mindful that as the lecturer and the researcher I was carrying out 'insider research'.

## **Participants**

There were nineteen pre-service teachers enrolled in the course and during the first lecture of the course, I provided verbal information about the study to all course members and asked for volunteers. Twelve students volunteered to participate by

indicating their interest on the needs questionnaire. During class time these students received letters explaining the study, including an outline of the ethical issues. They were then asked to complete and hand the required permission forms in to me.

Originally, I had anticipated having eight participants in the study, however I decided to accept all twelve of the volunteers. I had learned from the pilot study that due to a variety of reasons, attrition rates throughout the study can have an effect on participant numbers. This proved to be wise decision as participant numbers varied at each data collection point as the course and the study progressed. This information is presented below as well as an indication of the data collected:

#### **Data collected**

Method :	Number
Questionnaires:	
1. Needs assessment	<ul style="list-style-type: none"> <li>• 12 participants</li> </ul>
2. Long-term plan questionnaire:	<ul style="list-style-type: none"> <li>• 12 participants</li> </ul>
Focus group interviews:	
Midway through the course	
<ul style="list-style-type: none"> <li>• Focus Group 1</li> <li>• Focus Group 2</li> </ul>	<ul style="list-style-type: none"> <li>• One transcript 6 participants</li> <li>• One transcript 2 participants</li> </ul>
End of course	
<ul style="list-style-type: none"> <li>• Focus group 1</li> <li>• Focus group 2</li> <li>• E- mail “ interview”/questionnaire</li> </ul>	<ul style="list-style-type: none"> <li>• One transcript 7 participants</li> <li>• One transcript 1 participant</li> <li>• One transcript 1 participant</li> </ul>

Table 3.1 Record of data collected

## Organisation of data

**Questionnaires:** When the needs assessment sheets were completed and handed in, the responses from all course participants were recorded and collated onto a master sheet, which was a replica of the original sheet. Responses from study participants were coded using a numbering system, to differentiate their responses from other course members. In a similar way, responses to the long-term planning questionnaire were recorded and collated onto a master sheet, which was a replica of the original questionnaire.

**Focus group interviews:** At the completion of the mid course interviews, I listened to the audio-tapes to ensure each interview had been recorded successfully. This also enabled me to listen to the interviews away from the participants. I also wrote comprehensive notes in my research journal about significant information offered by the participants. This allowed me to respond to the data immediately and to formulate questions, which needed to be clarified in the final interviews. Davidson and Tolich, (1999) highlight the value of using “data collected last to fine tune your next cycle of data collection” (p.158). Data from the first set of interviews were able to inform questions asked in the final interviews. A similar process was followed at the completion of the final interviews. Listening to a recording of an interview provides an opportunity for the researcher to gain a sense of the interview as whole. Listening to the tapes gave me an opportunity to begin to understand the information offered by the participants.

To maximise the time I had available I decided to use someone else to transcribe the audio-tapes. On receipt of the transcripts, I read each one while listening to the audio-tapes. The transcriber did not know the participants and I needed to ensure each response was ascribed to the correct participant. In some places, the transcriber had difficulty discriminating between the voices of the participants. This can be a disadvantage of an independent person transcribing the tapes (Creswell, 2005).

I also needed to ensure the words from the interviews had been transcribed accurately. In some places, some of the words were transcribed incorrectly, particularly when vocabulary used by the participants, was unfamiliar or inaudible to the transcriber. An example of this was when technical terms or abbreviations were used e.g Numeracy project, or ERO (Education Review Office). I also found a large section of one interview had been completely missed out. I then transcribed this section and added it into the correct place on the transcript.

As I read the transcripts I was also able to add notes to describe what was happening in the interview other than the verbal communication. An example of this was when one of the participants stopped talking in order to refer to his assignment. This was not apparent by just reading the transcript. A limitation of a transcript is that it only records verbal communications that occur in the interview. The visual aspects and non-verbal communications that occur during an interview are largely missing from the transcripts. Cohen et al (2000) suggest an interview is a data collection exercise as well as a social encounter. The final transcript was a record of the verbal encounter with limited accounts of the social encounter.

Once I had checked all of the transcripts, they were sent back to the participants for checking. Each participant received a copy of the relevant interviews. A letter accompanying these transcripts asked them to add to or modify the transcripts paying close attention to their contributions. Of the twelve transcripts that were sent, four were returned. Three of these were approved by participants as needing no changes, while one was modified. This step contributed to corroboration of the descriptive validity of the data (Maxwell, 1992).

## **Data analysis**

The data was analysed following a grounded theory approach, which is consistent with an interpretive approach to research. Grounded theory is appropriate to use in this qualitative study because it allows the theory to emerge from the data (Mutch, 2005). This study focussed on the pre-service teachers' 'voice', and therefore the data analysis process needed to support this. I used the process of thematic analysis to identify the key ideas within the data. Davidson and Tolich (1999) suggest that

thematic analysis is a useful approach when analysing open-ended data such as interview transcripts, because it allows the researcher to manage and organise the data into categories and themes. The thematic analysis approach that I followed consisted of reading and re-reading the questionnaires and transcripts, and then highlighting tentative ideas, which were then collated into key themes (Le Compte & Preissle, 1993). This was a cyclic process which was repeated several times, to ensure the themes were representative of the data. This is a process of identifying, then organising and reorganising the key ideas into emerging patterns which formed common themes (Miles & Huberman, 1994). While following this process, I wanted to ensure that I approached the data with an open mind and tried to let it “speak for itself” (Mutch, 2005, p. 130). The three key themes to emerge from the data are defined below:

1. *Knowledge of the curriculum*: ideas relating to curriculum documents and related resources.
2. *Mathematical content knowledge*: ideas relating to mathematical content knowledge.
3. *Knowledge of contexts*: ideas relating to the development and implementation of mathematics programmes in schools and classroom settings.

I then coded all the data according to these three themes, collating data for each theme for further analysis (Le Compte & Preissle, 1993; Miles & Huberman, 1994). This data analysis is now reported in the next chapter.

## Chapter 4 - Results

### ***Introduction***

This chapter reports the analysis of the interview data and is organised into three main sections. The first section outlines the participants' professional practice experiences prior to the mathematics course, and the participants' experiences of the Numeracy Project. This provides background contextual information to support the participants' knowledge and confidence to teach mathematics. The second section of the chapter reports the results relating to participants' experiences of designing a long-term plan in mathematics. The long-term plan was an assessed requirement of the mathematics course. The third section reports the results about key issues for participants as they anticipate teaching mathematics in their first year in the classroom.

### ***Background experiences: Professional Practice***

The participants had all taught mathematics lessons on their Professional Practice placements. At the time of the mathematics course, participants had experienced four out of their five professional practices in a primary school. Their first third year practice had been held immediately before the course, while their last professional practice was due to be held five weeks after the course. While participants were on Professional Practice, they were obliged to follow the school's mathematics programme. During discussions in the interviews, I found that each of the participants had taught a variety of units from the mathematics curriculum throughout these four practices. A summary of some of the professional practice units is set out in the table below. Pseudonyms are used for each of the participants.

Strand/unit	Number of participants
Number only	Glenys, Lily, Kate
Number and statistics Number and geometry	Marie Daniel
Number, measurement and geometry Number, measurement and statistics	Sarah and Ann Ellen

Table 4.1 Strand/units taught on Professional Practice

This table shows that all participants had taught units from the number strand during their Professional Practices. It also shows that some participants had limited experiences teaching units from the algebra, statistics, geometry and measurement strands.

The Numeracy Project advocates that schools focus a large proportion of their time in the year on the number strand of the curriculum. This time varies according to the needs and programmes of different schools and schools determine their own areas of emphasis. The participants' Professional Practice experiences seem to reflect the emphasis on number. This meant that for Glenys, Lily and Kate they had only taught number, Marie and Daniel had taught number and one other strand, while Sarah, Ann and Ellen had had a more varied experience, having taught number and a combination of measurement, geometry and statistics.

While the focus on teaching the number strand reflects current practice in New Zealand schools, some participants were not gaining experiences teaching algebra, geometry, measurement and statistics before their first year of teaching. While they had one more placement before their ITE programme was completed, they had no control over the topic of the unit they would teach on this placement, therefore no guarantee that they would be able to teach a requested strand. It was highly likely that all participants in the study would begin their first year of teaching not having taught all of the strands in the mathematics curriculum.

Participants raised this as a concern in the interviews. They expressed a wish that they had had an opportunity to teach or observe a lesson in the "other" strands. While most were feeling confident to teach number, they really wanted to have had experience of teaching the other strands. They wanted to feel confident to teach all the strands before their first year. The unit plan assignment had provided an opportunity to complete a unit plan in a strand they had not taught. In the absence of a "project" in the other strands, they had to find resources and decide on teaching approaches for their units. While they had not taught the units, the participants unanimously agreed that the assignment helped them to feel prepared and confident to teach some of the units they had not taught while on Professional Practice.



### ***Background experience: The Numeracy Project***

The predominance of “number” teaching may reflect the presence and the influence of The Numeracy Project in schools at the time of this study. The Numeracy Project was introduced into New Zealand schools in 2002. The project provides resources to support the teaching of the number strand. This includes a Number framework, which contains specific outcomes for teaching number content. This content is separated into two sections - “number strategies” and “number knowledge”. Number strategies are defined as “the mental processes students use to estimate answers and solve operational numbers with numbers” while “number knowledge” is defined as “the key items of knowledge that students need to learn” (Ministry of Education, 2007d, p. 1). The project also provides a teaching model, detailed lessons for teaching and a diagnostic test for the assessment of number.

In the interviews participants acknowledged that the number strand would be a dominant part of their mathematics programme in their first year. Kate described the number strand as being, “a very strong” part of her anticipated programme:

Numeracy is the one thing that needs constant attention. I think numeracy and the knowledge of number is the root of everything else, if you’ve got a real strong base of that, then that’s where everything else stems from. It’s such a strong thing that you need to be really clear about.

She explained that number knowledge and skills were essential for learning in the other strands, therefore she needed to focus on this area more than the others. Other participants in the interview agreed with this, indicating that number held a dominant position over the other strands of the mathematics curriculum. They acknowledged that they were influenced by, and would follow the practices that they had experienced while on Professional Practice, which placed number at the forefront of mathematics teaching.

Participants liked the Numeracy Project programme and resources due to the detailed structure, and information provided by the project. They liked the content of the project, describing it as being “prescribed”. Similar comments were; “it’s instructional – it tells you everything you need to do.” (Tui), “Yeah, it’s set in stone.” (Daniel), “it’s concrete” (Ann ), and “it’s all laid out for you” (Ellen). They liked having the support and guidance of the programme. Kate said, “This is great as a beginning

teacher as it's at least one area of the curriculum that is concrete, that they tell you exactly what to do." Other participants agreed saying that the detail and structure of the Numeracy Project gave them confidence to teach number in their first year.

Participants expressed a concern that they would like to have this kind of structure for the other strands in the mathematics curriculum. When asked why, Sarah said, "The difference between this and the other strands is that there is nothing concrete to follow." This concern was shared with others who stated that they would like to have guidance and resources to help them to teach the other strands. They unanimously declared that they would like to have "a geometry project"!

The reason for this was that they felt that it was time consuming preparing units of work to teach in the other strands. Ellen said, "finding resources for my geometry unit was time consuming". She explained that she not only had to select resources for teaching but she also had to then make decisions about how to teach them in the classroom. She liked the numeracy project because the resource selection was done for her, and she was given guidance about how to teach each resource.

Others agreed with her saying that they valued the Numeracy Project resources because they were accessible and easy to use. Marie described the resources as being—"easy to understand, easy to follow through, and just straight forward". Like Ellen, Sarah liked the organisational structure of the resources because the resources indicated how the teaching activities were to be used in the classroom. She said, "it's clear in the numeracy project when the children are with the teacher. Whereas resources in other strands don't do this". She felt that with the other strands she had to make decisions about how to use different resources. She wanted to have the detail and support provided by the Numeracy Project, for the other strands.

Some participants highlighted a limitation of the project. Daniel liked the prescriptive nature of the project but stated that the prescription had the effect of making him feel like there was a, "a right" and a "wrong" way to teach number. He said:

This is the way they've set this up, and this is how you teach, this is it. You can't go, well, I know they've said this, but I think....you know, I'm going to do this. This is it. You get the feeling like you have to follow this, it's vital.

Sarah agreed, describing the project as being “like a bible” for teaching number. The prescriptive nature of the project material had the effect of making some participants feel like they had to religiously follow the instructions for teaching number. There was a concern that they taught it “correctly” but also they were unable to design their own teaching activities. Daniel continued, saying:

if you do something else you can justify and design how you want it.....but it would be in the back of my head am I doing this right? Am I teaching the right strategies according to the books?

For him, the content of the project had the potential to feel imposed and did not necessarily enable him as the teacher to make his own choices for teaching. Ann agreed, “you can’t branch out with the numeracy project, this is it, that’s how you do it”. While the pre-service teachers liked the guidance the Numeracy project offered, the prescriptive nature had the potential to restrict their teaching.

### ***Designing a Long Term Plan***

This section reports results relating to the process of completing the long-term planning assignment. It includes three sections; a description of the long-term planning task, use of the curriculum as a resource for planning, and a reflection on the long-term planning process.

### **The Long Term Planning Task – contextual information**

The first assignment for the course was to complete a long-term plan in mathematics. Pre-service teachers had to select one level of the curriculum from levels 1 - 4 and then complete a fictitious plan for a year, for that level. Using *The New Zealand Curriculum* (Ministry of Education, 2007a) students were required to make decisions about how they would cluster the achievement objectives together to make up units of work. They then needed to decide on the placement and the order of these units of work throughout a year. A requirement of the plan was that all decisions had to be explained and justified. The format for the plans is attached (See Appendix C).

Once these decisions were made, students were required to summarise the key mathematics ideas to be taught in each unit. The purpose of this was to give students

an opportunity to explain the mathematics that would be taught in each unit. It was an opportunity for them to explore the mathematical content suggested by the achievement objectives. The expectation for this section was explained by way of a question i.e. “what is the mathematics being taught in this unit?” Students could record these ideas on their plans as learning outcomes or list the mathematics content they intended to teach.

The assignment also required students to decide on possible contexts for teaching mathematics, for one unit per term. The purpose of this was to encourage students to make links between their mathematics units and other curriculum areas. Examples of these were discussed in class, such as teaching a measurement unit alongside a physical education unit on athletics sports. Some students used this section of the plan to incorporate the key competencies from the *New Zealand Curriculum* (Ministry of Education, 2007) into their plans.

At the beginning of the course students were briefed about the assignment. In addition to this, several learning experiences about long term planning were provided within lecture sessions. The pre-service teachers critically examined a variety of blank formats for long term planning, including those suggested in the Numeracy project resource material, and critiqued completed plans sourced from local primary schools. Long-term planning assignment exemplars from previous years were also made available for students to refer to throughout the course. One lecture was dedicated to allowing students time to work together to write their plans. This was an optional lecture, which the majority of students chose to attend, and was consistent with past courses. My role in this session was to guide them in the planning process, to offer advice and information about long term planning, and to clarify assignment requirements.

### **Use of the curriculum as a resource for planning**

As stated previously, participants had to complete the long-term planning assignment using the new curriculum. At the beginning of the course, they had several questions about the content and structure of this new document. Examples of these questions were - “what is in the New Zealand curriculum?”, “what are the maths strands?” and

“what are the achievement objectives for maths?” During lectures, these questions were addressed, with students identifying the strands, the sub strands and the achievement objectives, from levels 1- 4 in the new document. The new curriculum emerged as an analysis theme from the interview data.

### **The achievement objectives**

A key concern that emerged was the understanding of the meaning of the achievement objectives. Several participants explained that they had difficulty understanding what the achievement objectives actually meant. A common difficulty was that the achievement objectives were too broad; Sarah said, “I found the achievement objectives to be very broad”. The effect of this was that she did not fully understand them. She needed and was looking for more guidance from the achievement objectives to help with her planning and teaching. She was used to working with the achievement objectives in the old curriculum, which were more detailed. In addition to this, the old curriculum provided suggested learning experiences, which helped to explain the meaning of the achievement objectives.

Ann commented that the broadness of the achievement objectives in the new curriculum could be beneficial to teachers, as they could be interpreted, and therefore taught, in a number of different ways. She said, “The new document is much more forward and could lead to so many more things”. However, she acknowledged that in her position as a beginning teacher, she wanted to have more guidance about what she had to teach. She said, “It gives us too much freedom. I don’t like having tonnes of freedom. Within reason, I like to be told what to teach.” The lack of clarity in the objectives gave her too much freedom when planning. Like Sarah, she preferred and was looking for the curriculum to provide her with more detail to help her understand the meaning of the achievement objectives. She was also looking for more direction to guide her decisions about planning and teaching.

Other discussions about the achievement objectives revealed further perceptions about the curriculum.

### **Mathematical terms**

Several participants stated that their understanding of the achievement objectives was limited because they included several mathematical terms that were unfamiliar to them. Ellen expressed this by saying, “I didn’t even know what some of the words meant!” Tui had similar difficulties, describing some of the vocabulary in the achievement objectives as being, “lingo”. She described a previous experience when she had been given a mathematics long-term plan while on Professional Practice. She explained that it had had limited value to her because it was, “it was just a bunch of words”. Her lack of understanding of these “words” meant that she was not able to plan and teach maths confidently as there were mathematics terms used in the achievement objectives that she just did not understand.

Examples of words that had given her difficulty were - knowledge, strategy and algebra. She said, “I didn’t know the difference between “knowledge” and “strategy” ....I’ve heard the terms before but didn’t know what they meant.” And later on in the interviews when she was talking about the achievement objectives she said - “ they’re still just words, like algebra’s just a word. I don’t really know, I couldn’t tell you what it is.” Having completed the long-term planning assignment, she still felt that she had several gaps in her understanding of the achievement objectives. She admitted that when this happened she would avoid teaching those areas of mathematics. She said, “When I don’t understand the meaning of the actual words there is no point in having a closer look at them.” There was agreement from other participants in this interview, indicating that when they did not fully understand some of the mathematical terms used in the achievement objectives they would not feel confident or able to teach it.

Glenys wanted to know about the meaning of the achievement objectives so that she could feel fully prepared for teaching when she went on her next professional practice. She said, “It helps to understand the terminology, so that we can discuss this content with experienced teachers.” For her, “being prepared” meant that she would be able to work alongside teachers in her school to plan mathematics units using the new curriculum and to be able to do this, she wanted to have a good understanding of the curriculum content.

Other discussions indicated the importance and value of identifying the key mathematics ideas indicated in the achievement objectives.

### **Identifying key mathematical ideas in the long-term plan**

Most participants reported that completing the key mathematics ideas section of the assignment provided them with a valuable opportunity to explain the achievement objectives, particularly achievement objectives they were uncertain about.

Ellen enjoyed writing the key maths ideas as it made her clarify the achievement objectives and helped her to define the content of her units. She said, “I just found it useful to know exactly what I needed to teach the children”.

Other participants agreed saying that defining the mathematics content in the achievement objectives allowed them to write learning intentions for their units, which defined the content for teaching. Marie commented that writing learning outcomes for each unit was easy because she had written key maths ideas on her long-term plan.

Daniel added that he found the key maths ideas “really, really important”. He found that by writing learning outcomes from the key maths ideas, he was able to decide on the teaching approaches he would adopt for the unit. He did this by looking at the verbs in the achievement objectives and the learning outcomes. He said, “um to be honest I found it pretty useful like, for example, when you are saying you’re describing, investigating...that’s pretty much the key idea. Then you like say, design a lesson from there.” He used the key ideas and verbs to not only define the content of the achievement objectives but also to guide the decisions he made about the teaching approaches to be adopted for each unit.

Other participants indicated that they had found it useful breaking the achievement objectives into smaller parts for teaching. Lily liked the fact that she could “actually break up the AO’s more in class”. Writing the key maths ideas helped her to define the maths content and allowed her to break up achievement objectives into manageable “parts” for teaching. Doing this helped her to feel more confident about the mathematics content that she was teaching.

Glenys found the key maths ideas section valuable as it helped her to make decisions about the length of each of her units. It gave her a quantifiable amount of work, which allowed her to gauge the length of each unit. Using this information she was able to make decisions about the length and placement of the units throughout the year.

Participants acknowledged that the key maths ideas section of the long-term plan was a feature of the assignment, and a task that they might not do on a long-term plan in their first year teaching. Despite this, they unanimously agreed that it was valuable exercise to have done before their first year of teaching. The reasons for this were - it gave them an opportunity to clarify the content of the achievement objectives, to write learning outcomes from these objectives, to estimate the length of possible units and to make decisions about possible teaching approaches. It was a means by which they gained a greater understanding of the intended content of the mathematics curriculum.

### **Resources used to support the understanding of the new curriculum.**

Another aspect related to curriculum planning were resources other than the new curriculum. Throughout the interviews participants indicated they had used a variety of resources to help them complete their plans. They all indicated that they had used the 1992 mathematics curriculum document to help them to clarify the intended mathematical content of the achievement objectives in the new document. The main section mentioned was the achievement objectives. Ellen said, “I read the old achievement objectives because I found the new ones, well I didn’t really understand some of them, whereas the old ones were sort of kind of easier”. Daniel agreed saying “Now it’s quite brief, like I read the achievement objectives and I had to refer to the old ones because I didn’t quite understand it”. Kate explained that she looked at the old achievement objectives to gain meaning about the new. She described her feeling of satisfaction when she understood the content saying – “so this is what it means!”

She expressed her concern that if she had not done this, then she would not have been able to clarify her understanding of the achievement objectives in the new document until her first year teaching. She said, “if I hadn’t done that, I probably wouldn’t have



known until next year.” There was a sense of relief from Kate that she had gained this knowledge before she had started teaching.

Another resource that participants referred to throughout the interviews was The New Zealand Mathematics website (nzmaths, 2008). This resource is written by the New Zealand Ministry of Education and provides various resources to support the implementation of mathematics programmes in New Zealand schools. This resource was used extensively throughout the mathematics course, by the course lecturer. Participants who used the website to complete their plans, used the “units of work” section. These units were helpful because they contained suggested groupings of achievement objectives for each unit, descriptions of the mathematics content being taught in the units, and learning outcomes for the units. They provided guidance and detail that participants needed to complete their plans.

However, some participants did not feel confident to use this resource. For example, Sarah and Kate did not use the website saying “there was too much stuff out there on it”. They acknowledged that there was valuable information on the website but were overwhelmed by the quantity of the information that was available to them. Despite the lecture experiences, they were unsure how to access the information that they needed. These two participants relied on the old curriculum to help them complete their plans. The section of the old document that they used was the glossary. They used this to define mathematical words in the achievement objectives that they did not know. They also talked about using a dictionary for the same purpose.

All participants reported that because they were familiar with and understood the old curriculum, they would be keeping the document, and valuing it as a resource to support their future teaching. They used the old document to construct their understanding of the new but indicated that there was a need for additional support material to help them to clarify their understandings of the new document. In the absence of such material, at the time of the study, the old curriculum, dictionaries and the nzmaths website were used extensively.

### **Sequence and relative emphasis of the strands**

In order to complete the long-term plans, participants needed to decide how much time to spend on each unit in a year. To do this, they referred to the Venn diagrams in the *New Zealand Curriculum* (2007). Participants spoke positively about these diagrams because they helped them to decide how to apportion the strands throughout the year. Sarah said that she used them because they told her “how long to focus on something”. Ellen commented that in order to complete a long-term plan, it was essential to have knowledge of the curriculum and the Venn diagrams. While most participants commented that the inclusion of the Venn diagrams was beneficial to their planning, they agreed that the curriculum needed to include specific information to explain the intent of the diagrams. Lily said, “it was useful, but lacked specific detail”. Sarah concurred with this, adding that in the absence of the detail she referred to the old curriculum to provide her with the detail she needed.

Having decided the proportions of the strands throughout the year, participants then had to decide how many units of work they could have for each strand at their chosen level. This involved participants looking at various combinations of achievement objectives within strands. Louise commented that this involved new learning for her due to the reorganisation of the content of the new document. She said, “ it was a big step moving from the old to the new as you had to understand where and what had been put together, for example number and algebra”. She said that there were numerous unit combinations that she could make:

in the new curriculum you see things written down there and all chunked into three strands – and then you actually have to take it from those three strands into twenty different units that you teach throughout the year (Ann).

She found this a time consuming process and was looking for more guidance from the curriculum to help her make these decisions. Other participants described a similar process. They put units of work together by splitting and joining the achievement objectives. When making decisions about the length of each unit, they took into account the number of achievement objectives they anticipated teaching and estimated how long these would take to teach. When asked how she decided the length of the units, Sarah said:

well I read the AOs, and then decided how long I thought it would take a class of like, level 2 to achieve that. And that's how long I based, like; I did it for a week or two weeks.

Several participants used the units of work on the nzmaths website to guide their decision making process. These units were like a model or an exemplar of possibilities for each unit. The length of the units was estimated based on these models and as well as the number of achievement objectives participants had selected to include in their units.

The units were then ordered throughout the year. Some participants decided to do this by sequencing the units so skills and content were taught in a certain order. An example of this, from Ann's plan, was a number unit on basic facts placed before a number unit on addition and subtraction. She justified this by saying she wanted students to have knowledge of basic facts before they learnt addition and subtraction strategies. In the justification statements for their plans, participants called these "pre-requisite skills".

The placement of units was also decided by the fictitious contexts that students chose to include on their plans. Glenys offered two suggestions for this; doing a measurement unit alongside a physical education unit involving cross country running, and doing geometry (shapes) alongside a visual art unit. She said that by doing this, "you can also make it (mathematics) more fun, and you can reinforce the learning by integrating it." Therefore, the timetable for other curriculum areas needed to be considered when placing mathematics units onto the long-term plan, so that integration could occur.

### **The place of "number" when planning**

All participants used both the new curriculum and the Numeracy Project resources to help them to complete the number and algebra section of their plans. The key difference they recognised between the old curriculum and the new curriculum was that the number and algebra strands were combined. They also noticed that some of the number framework content was referred to in the new achievement objectives. The main example of this was where the knowledge and strategy headings were used as headings in the number and algebra section of the curriculum. Participants liked

this feature of the new curriculum, as the old document did not have direct references to the Numeracy Project content. They commented that they liked seeing how the Numeracy Project content aligned with the curriculum.

However, they acknowledged that to complete their plans, they found that they had to refer extensively to the numeracy project resources to provide them with specific detail about how to organise their units and to identify the key maths ideas within these units. They followed the planning structure of The Numeracy Project, organising their “number” units into the strategy headings of addition and subtraction, multiplication and division, and proportions and ratios. They noted that this information was not stated in the curriculum document. They used the ‘units of work’ section on the nzmaths website for numeracy to help with this organisation and used the Number Framework to write the key maths ideas content on their plans.

Participants were required to include at least 50% number and algebra content on their long-term plans. They used the Venn diagrams to guide their decisions about the number of weeks they would spend on number and algebra per year. Several participants began their plans by allocating their number units throughout the year. Daniel stated that he started his plan by placing a priority on number, “number’s obviously going to be the main part of the plan.” Others, like Glenys, referred to the Venn diagrams and allocated a specific percentage of number teaching at their chosen level. She attributed sixty percent of her year to teaching number.

Once participants had made the decisions about how much time to spend teaching number, they then had to place the units on their plans. Marie described the process she followed for this, “you put number in and then just shove the rest in!” Ann explained a similar process, “first you find a big area where you can stick the number in quite comfortably and then some units flowed on from there.” Others had also followed a similar process by placing number units on their plans before the units from other strands.

### ***Reflections on the LT planning experience***

While this study did not set out to evaluate the long-term planning assignment as required for the mathematics course, three common themes emerged from the data. These themes; “the big picture”, “decision making” and “the long-term plan as a “real” document” are reported in this section.

#### **“The big picture”**

During the interviews, participants discussed the benefits of completing a long-term plan in mathematics for an assignment. Participants unanimously agreed that the main benefit of completing the plan was that they now had an overview of a mathematics programme for an entire year. They used the following phrases to describe the plans; it provides a “big picture” (Glenys), provides structure (Ann), acts as a guide (Sarah), gives me vision (Tui), paints a picture (Marie) and provides direction (Kate).

Participants valued the completed plans because they provided a yearly overview of a mathematics programme. This was in contrast to their Professional Practice experiences where they only focused on a five-week block of teaching. Marie described the five weeks as being “just a snippet” of the year, while Louise described it as being just a “small part” of the year. The process of completing the plan as the assignment gave them an experience that they would not have had until their first year teaching. Participants agreed that they liked having “The Big Picture” for their mathematics teaching as it gave them structure and direction beyond a five-week experience.

Most participants explained that while they had seen unit plans and lesson plans on Professional Practice, few had seen a long-term plan for mathematics prior to the mathematics course. Marie was one participant who had seen a plan on Professional Practice, but said at the time she was given it, she had no understanding about the content of the plan or the process that had been undertaken to put the plan together. She described it as being “just words on a page ...blah blah blah”. The task of completing the assignment had helped her to understand the content and the process that went into designing a plan.

Daniel had also been given a plan while on Professional Practice, but stated that prior to the course and completing the assignment he had not understood or seen the relevance of writing a long-term plan for mathematics. He said, “When I get a long term plan on professional practice I don’t pay much attention to it - it’s there to fill up my folder. Now I have done it, I can see where I am going”. He explained that while he was on Professional Practice his focus was on meeting the requirements that he needed to meet to complete the practice. The long-term plan was an example of a document that he disregarded, as it was not deemed important for his success while on practice. He admitted that he solely focussed on documents that had an immediate impact on his five-week teaching practice.

Kate explained that she liked having the structure of the plan to support her mathematics teaching. She said, “it stopped me as the teacher from going off track, it keeps me focussed and means I’m not walking around blind”. Later on, she said, “I’m a big picture person. I need to see exactly where I am going rather than going off in some other direction.” A positive aspect of the plan was that it provided her with a direction to keep her mathematics teaching focussed. Marie agreed with this saying - “I always feel more confident when I know where things are going - it’s just random then I sort of feel lost, and it doesn’t give me direction”. For both Kate and Marie the long-term plan was a document that allowed them to feel focussed and organised with their teaching. It was a mechanism, which kept them on a planned teaching path for the year as opposed to having to make up the programme as they went along. They liked having this direction and framework to follow, as it made them feel secure and prepared for teaching mathematics. Lily liked having the plan in place as it helped her to feel ready to teach mathematics saying - “I like to know what I am doing – it makes me feel confident”. She explained that the plan enabled her to make decisions about the organisation and management of her mathematics teaching, and assisted her selection of resources and equipment for her units. Being organised and prepared for teaching mathematics made her feel confident.

As reported earlier in section one, many participants had not had opportunities to teach all of the strands in the mathematics curriculum. Marie liked completing the long-term plan because it helped her to work with the strands and units that she had

not taught on Professional Practice. She said she liked completing the long-term plan because:

it's looking at the other strands as well. I've only seen number, so it's actually thinking about the other strands as well. Looking at geometry and that sort of area that I haven't even looked at, so it's good to be able to put it down on paper and be able to think ahead.

The experience of completing the plan for the assignment provided her with an opportunity to learn about the areas of the curriculum that she was unfamiliar with before she started teaching in her first year.

### **Decision Making**

Another positive aspect of completing the plan as an assignment was that it allowed participants to make their own decisions about their mathematics teaching. This was in contrast to their Professional Practice experiences where they were unable to make their own decisions about the mathematics units that they taught. The reason for this was that associate teachers usually prescribed the units for participants to teach while they were on their placements. Marie stated, "When you go into schools they've planned their year, they've done their long term plan and they don't really want you to come along and muck it up. It's quite prescribed". Participants felt they were obliged to carry out their associate teacher's plans, and were unable to make their own decisions about what they taught. Glenys shared this concern saying, "often we are just told, even still in third year, we're told, I want you to do this and this. For my integrated plan they actually handed me a syndicate plan, which was my third year practice". In this example, she states that she had limited opportunities on her practice to make her own decisions about the mathematical strands she could teach. She was looking forward to being able to make decisions about her mathematics teaching in her first year teaching.

Other participants agreed that they liked having the autonomy to make their own decisions about what they would teach. Having been through the process of completing the long-term plan, most felt that they could now easily put a plan together for their own class. They acknowledged that while they completed the plan at one curriculum level, they could now easily modify the plan for different curriculum levels. The strength of the assignment was that it had made them engage with learning

about the mathematic curriculum. Having this knowledge before they started teaching made them feel confident to write plans for future classes. They acknowledged that while they had one version of a plan, they would need to adapt future plans to meet the needs of the students in their class. The assignment experience gave them the confidence to do this.

### **The long-term plan as a “real” document**

Participants made several comments about valuing the plan, because they saw it as a “real” or “authentic” task that teachers would engage in. Kate said -“it is a real task that teachers would do - the long-term plan is important because we’re actually going to do it - it is actually something I would do if I was a teacher”. All participants agreed that the assignment had value, because it had future use for them as teachers and was not just seen as an assignment to complete a requirement for their course. It was an opportunity for them to engage in a process before the actual event and to complete a long-term plan before they started teaching. This simulation of a task for teaching helped to make them feel prepared and confident about being able to do a future teaching task. They liked having the course support to complete the task before they had to do it independently in their first year.

Kate and Marie acknowledged that they were thankful for having completed the task before their first year because it meant that they had the knowledge and confidence to participate in future planning meetings in a school. A journal entry noted Glenys’ excitement as she anticipated being able to go into a school being confident in her knowledge of long term planning and the curriculum. She said, “imagine being able to go into school with your long term plan knowing what to do. How cool being able to talk about it with your associate”. She talked about using her plan as a document that she would use in a future interview for a teaching position. She deemed it useful as it was an example of her understanding of the planning process as well as a reflection of her curriculum knowledge in mathematics. She wanted to show future employers that she knew and could plan something about the mathematics curriculum. It was also important to her, that she could be an active participant in future planning meetings alongside other teachers.



Like Glenys, Kate wanted to go into schools knowing how to do a long-term plan. She said, “well, you want to go into schools and um, have learnt something... you’ve got this knowledge....as an emerging teacher, you kind of want something to go in with. It’s hard to explain”. As an “emerging” teacher, she said, “You can now participate in unit planning and long term planning because you have done it. You can feel a part of this going into a school, rather than sitting there and going “I have no idea how to do this”. She wanted to go into a school having the knowledge to complete a task that “real” teachers engaged in. She said this made her feel confident and prepared to contribute alongside these teachers.

Having completed the plan, Sarah also liked knowing about the process that was involved. She said, “you feel like you know there is a lot more, how to fit with each other. Just the confidence spanning over a year. Because if we didn’t do this, and I went into a school and we were designing a long-term plan, I’d be sitting there not saying anything, because I wouldn’t know what they were actually doing. Yeah, just knowing that there is so much behind it.” Completing the plan gave her an opportunity to clarify the process that may happen in a school. It helped her to feel confident and prepared to do the task that previously she had not understood.

Marie agreed with this, stating that the experience of completing the assignment had made her feel more prepared to participate in planning meetings in a school. This was in contrast to a previous experience of writing a Social Studies long-term plan at a syndicate meeting. She said, “it went right over my head, I had no idea what they were doing. Doing the maths plan was really good”. Now that she understood the process, she felt confident to replicate the process of writing a long-term plan for mathematics in her first year of teaching. Like the others, she valued completing an assignment that represented a task she would do as a “real” teacher.

Participants remarked that they were relieved to have done a task that they would be required to do in schools and that could be shown to “others” in authority over them. These “others” were tutor teachers, syndicate leaders, Associate Principals, Deputy Principals, Principals and Education Review Office representatives. They were pleased that they had done a plan before they had to do it in a school. Completing the

assignment before teaching meant that it was not a “new” task for them in their first year.

While this study did not set out to evaluate the effectiveness of the long-term plan as an assignment, participants all agreed that it was a valuable task to have engaged in before they started teaching. When asked if the task should remain as a compulsory assignment in the mathematics course, they unanimously agreed that it should. Several mentioned that it should be a compulsory assignment in other curriculum courses. Marie said, “yeah I don’t know why we don’t do it in everything, it would be so much more helpful”. Daniel agreed saying, “I’d feel a lot more comfortable taking a maths programme now that I have done a long-term plan, if we did it in all subjects I’d feel a lot better about starting out as a teacher”. He added, “it definitely makes me feel more comfortable with the maths curriculum, compared to others”.

They agreed that doing the plan had given them the confidence to individually or collectively write a long-term plan in mathematics. The task added to their sense of being prepared for their first year as well as it helped to make them feel like “real” teachers. This sense of “reality” was consistent with the position participants were asked to adopt at the outset of the course i.e. “to put your teacher hat on”. The long-term planning task enabled them to do this.

### ***Key Issues as pre-service teachers look forward to their first year teaching.***

In the final interviews, I asked participants to visualise themselves standing in the classroom at the beginning of the year and to think about what their needs and concerns were as they anticipated teaching mathematics with their new class. This section reports the findings that relate to these needs and concerns. They are reported in three sections; organisation and management of the classroom, students and their mathematical content knowledge, and making the transition from student teacher to beginning teacher.

## Organisation and management of the classroom

The participants' first concern was how they could group their children at the beginning of the year. They hoped that there would be assessment information available for them to use from previous years, and wanted to know how they could use this to form their initial groups. They also wanted to know what assessment "tools" their school would expect them to carry out in the first weeks of school and how to implement these at the same time as teaching. Examples of assessment "tools" that were mentioned were - "The Diagnostic Test", "GLOSS" forms, "ARBS" and pre and post tests. They then wanted to know how to use this assessment information to form their groups for instructional teaching.

There was a consensus among the participants that they wanted to dedicate the first few weeks at school to setting up a group teaching system for mathematics; that is, the ability grouping system advocated by the Numeracy Project. This system suggests that teachers begin a mathematics lesson with a whole class activity – referred to as a "hotspot", then teach different ability groups throughout the lesson. Children follow a rotational system of activities in the lesson either spending time working with the teacher for a "teaching" lesson or working independently on a variety of mathematical learning activities. The participants were concerned with how to establish this rotational system for the mathematics lesson. Sarah states:

my concern is establishing the routines, getting them used to starting with a hotspot and then putting them into groups. Getting them to do the activities, even if they're not maths games, just so they can get used to shifting around, and having one group being with me.

Most participants had seen this system in schools during their teaching practices, but because they had never been in schools during the first few weeks of a school year they were uncertain about how to set this system up from the first day. There were no concerns expressed about the "teaching" part of the rotation, although "the group box", which is an independent part of this system, was mentioned several times. Participants were concerned about which resources to put into the group boxes so that students were engaged in meaningful learning during this time, and also how to manage this group while they were busy "teaching" another group. They acknowledged the complexity of this task. Marie and Glenys were adamant that the

tasks and resources that were selected for group box use, needed to engage children in meaningful learning about mathematics. Glenys described these tasks as having to be “adequate, useful and relevant.” Both Glenys and Marie had previous experiences while on professional practice, where the group box and independent activities had not worked effectively as a teaching method:

I have to say that I am not really a fan of group boxes as this stage - I see too many kids just mucking around during group box time - personally, I would have no group boxes Mon -Thurs and have a whole class, maths, games box session, during maths time on Friday – if I had that choice (Glenys).

Because of her experiences, Glenys had decided not to include group boxes as part of her daily routine. She wanted to ensure that she could manage all of the children in her class during maths time and that they were all engaged in meaningful learning experiences throughout the entire maths lesson.

Marie also had misgivings about the group box, “they’re not really learning anything. It was the same games, every day and that’s boring, and not actually learning anything.” She said that for group boxes to be effective, they had to contain a variety of resources that would engage children in mathematical learning during the lesson. She was determined to provide effective resources in her group boxes if she chose to adopt this system in her first year teaching.

Another concern raised by participants was that they wanted to know what resources and equipment would be available for them to use in their classroom. They had clear ideas about what they wanted to use but were unsure as to whether they would have these at the beginning of the year, “like where do you get them from and you have to make sure they are suitable for your age group and ability?” (Lily). Not only did Lily want them to be available but she also wanted to make sure that they would meet the needs of the children in her room. Ellen wanted her resources and equipment organised before starting to teach:

I have been to schools where there’s maths equipment everywhere and I’m thinking about things I will need to use, because I want to be ready to go, and I don’t want to have to find it.

She wanted this information so that she could make her own resources during the holiday period before school started. This was important because she wanted to establish her management and organisational routines for working with equipment in the first few weeks of school. From previous teaching experiences, she had seen the disadvantages of not having this set up properly at the beginning of the year.

### **Whole Class Teaching**

Most participants expressed their concern that during their Professional Practice they had had limited experiences of whole class teaching in mathematics. Whole class teaching was defined as being where the teacher taught their whole class for the duration of the lesson without ability grouping the children. Participants were concerned that while they were familiar with group teaching models as advocated by the Numeracy project, they did not really know how to implement a whole class teaching model.

Participants wanted to know what units of work could be taught following a whole class model. There were several references made to units like statistics and measurement. Marie described her experiences of whole class teaching in a statistics unit as being a “new experience”, saying, “my last big lesson was full class and I found it so strange, it felt so new and not natural.” Ellen stated that she would liked to have seen a whole class lesson before she started teaching. Like other participants, she said it would have been helpful to have seen the first lesson in a whole class unit as well as see the actual structure of the lesson.

Once the unit topics had been decided participants then wanted to know what resources they would use in a whole class lesson. Several references were made to using “worksheets”. Ellen wanted to know if, “you just hand out a bunch of sheets and they do it?” There seemed to be an assumption that “worksheets” were an integral part of whole class teaching model. Participants also wanted to know if they should use equipment e.g. rulers in a whole class setting. They were then concerned about the organisation and management of this equipment with a whole class. There was uncertainty about the routines they could establish to manage this in their classrooms.

Marie stated that the main challenge she had when teaching her statistics unit was being able to cater for individual needs within the whole class structure, “you had to think about what you were going to do with the people who have finished early, the one’s that are really struggling.” Other participants wanted to know how to ensure that their teaching would be effective for all of the children in the whole class setting, particularly children with “individual” needs i.e. either remedial students or gifted and talented students.

## **Assessment**

Participants wanted to know how to assess learning in “the other” areas of the curriculum, namely in the measurement, statistics and geometry strands. It was noticeable that they did not express any concerns about assessment practices in the number area of the curriculum. Marie was particularly concerned about what assessment methods or “tools” she could use to assess learning in these “other” strands -“what is the best, like, there are a whole lot of different ways of doing it, which ones are the better ones to use”. She was aware that there were several different options available for use in the classroom and wanted to know which of these options were appropriate for her to use. She explained that she had seen, “pre-tests and post tests, a couple of diagnostic things, and the ARB stuff”.

Kate had a similar concern about which assessment methods to use in “other” strands, as she had only seen pre-tests and post-tests used while on Professional Practice. She wanted to know if the same tests could be used at the beginning and end of a unit and if so how would this give her information about what the students had actually learnt during the unit. She was also concerned with knowing how much to assess in each unit. Like Marie, she knew that there were other a variety of methods available for her to use, but had questions about what and how to use them.

Ellen, Ann and Marie all indicated that they wanted to use a variety of assessment methods in their mathematics programmes such as student observations, questioning, work samples, note taking and student journaling. They were adamant that they needed to include these alongside “testing” methods. Marie said that she wanted to do more than, “just the test thing!” Participants knew that in their first year they would

have an opportunity to use a variety of these methods, but there was a feeling of uncertainty about where and when to do this. They were wanting and expecting guidance from their schools to help them make these decisions.

### **Pre-service teachers and their Mathematical Content Knowledge**

Several participants were concerned about their personal mathematical content knowledge as they headed into their first year of teaching. Kate, Ellen and Tui were concerned about how their lack of knowledge in some areas of mathematics would affect their ability to teach effectively - “For me it’s maths content.... I really don’t know, honestly, how to teach some areas” (Kate), “I think my number knowledge is quite terrible and I really need it to get better. If you had the content it would be so much easier to figure out how to teach it.”(Tui), “content is an issue for me” (Ellen).

Lily acknowledged that for her, content knowledge was important so that she could plan and implement programmes to meet the diverse needs of all of the children in her classroom. She stated that she needed content knowledge so that she could plan teaching experiences to develop mathematical ideas in a unit and to know how to extend children when necessary. She said - “Knowing – really, really knowing the content before going in and teaching it so that you are able to extend kids.” She was concerned that if she did not know some of the maths content before she had to teach it, then she would not be able to plan learning experiences to meet the needs of her students, particularly her “able mathematicians”. Marie acknowledged that mathematical content knowledge was an important part of being an effective mathematics teacher:

Maths is sort of something that you can’t bluff your way through, so you sort of have to need to know it...if you can’t understand fractions yourself, then how are you supposed to be able to teach it to kids? How are they going to understand it if you don’t?

For her, having mathematical content is an essential part of being a credible and successful teacher of mathematics.

Some of the teaching approaches advocated by the Numeracy Project were highlighted as an area of content knowledge that concerned participants. The main

concern was the difference between the Numeracy Project approaches to teaching number, compared with the approaches that participants had been taught at school. A challenge for participants was that they had to learn how to teach the Numeracy Project lessons as well as learn new ways to “do” the mathematics as advocated by the project. One of these “new ways” was the difference between using number strategies and algorithms when solving number problems. Ellen explained;

I was never taught how to use strategies, it was all algorithms, it was all written. It wasn't done in your head, so actually teaching it to children, I find it so hard. In my head, I see the algorithm. I don't see what they are supposed to see.

She said that as she taught the project material she constantly had to learn different ways to solve the number problems. Tui agreed -“I am learning to change my strategies in my head”. Both agreed that that where the content was different from their own schooling experiences there was considerable new learning to be done. The development of this content knowledge was an ongoing process as they taught from the project material.

Ellen decided to complete her unit plan on geometry with a focus on “shape”. This was an area that she had not taught, and did not feel confident to teach, because of the content. She justified the selection of this topic:

I need to know how to do it myself. What I need to learn is what they need to learn....like what shape is. I've got to learn it. I'd rather learn it now than when I'm in the class.

She was aware that she would not be able to teach this unit effectively if she was unable to understand the content herself. She wanted to know the geometry content before she taught it to children.

During the process of writing her unit, I sat with her and helped her to clarify the meaning of some of the vocabulary associated with teaching the “shape” unit. She used the glossary from the old curriculum document and a mathematical dictionary to help define some of the words she did not know. An example of this was defining the difference between polygons and polyhedrons. She also relied heavily on using actual teaching resources like the “Figure it Out” series (Ministry of Education, 2008) to



help her clarify the content. She explained that as she looked at different teaching resources she not only made decisions about what resources to use for teaching but also learnt about the mathematics content that she needed to teach. She said, “The resources helped me to see what they’ve got to do....if it’s in the book then they’ve got to learn it.” There was a sense that the resources had a dual purpose i.e. for selection of teaching activities and acted as a content tutorial. Other participants agreed that they also relied on teaching resources to help them to learn mathematical content for teaching.

Tui particularly liked the video segments on the nzmaths website because they were a practical resource that she could easily access to increase her number knowledge. She said - “They showed you how to use the number equipment – it made such a difference. Actually seeing it being taught would give you a lot of confidence. Because we’re not seeing everything that is being taught it’s so much harder to know where to start.” The video segments allowed her to gain mathematical content knowledge in areas that she needed to learn before she taught them to children.

Sarah also used resources to clarify the mathematics content that needed to she needed to teach. However, she explained that if she looked at a resource and did not understand the mathematics in it or how to use the resource in the classroom then she would not use it. If she could “do the maths” then she “would teach it”. Ellen indicated that a consequence of not knowing content was that that she could choose to omit that area of mathematics from her programme; “well, if you know something you’re more likely to teach it.” She was confident to teach units that she understood but not so confident to teach units that she did not understand. This had an impact on the decisions she made about the areas of mathematics she would teach in programme.

Participants agreed that the next step they needed to help them to develop their mathematical content was experience teaching in their first year. They were looking forward to having the opportunity to teach the units of work they had not taught and to learn new content as they did this. Sarah said, “next year we will have new experiences teaching units that I haven’t seen, haven’t taught or don’t understand the content of.”

Tui made a final comment, “initially I was honestly petrified of teaching maths because my maths wasn’t flash, but now it’s quite exciting.” At the end of the course she could see that there were resources available to help her extend her mathematical content knowledge, she acknowledged that she would gain more knowledge from her future teaching experiences and that her first year teaching was a valid part of the ongoing learning process of how to teach.

### **Making the transition from pre-service teacher to beginning teacher**

During the second interview, I asked participants to comment on what they saw as the significant differences between their Professional Practice teaching experiences and their anticipated teaching experiences as a beginning teacher. The main difference was the shift from teaching in a five-week block to teaching over a full year. They indicated that there were limitations to spending only a five-week period in a school while on Professional Practice. Daniel and Tui described this five-week period as being a discrete portion of time that was isolated from a whole year classroom programme. When on practice, they did not get a sense of what happened with their class before or after the practice. They admitted that when they were on professional practice they were not concerned with the wider programme, and did not enquire about it, as their focus was on meeting the assessment requirements of the placement. Daniel said, “I wouldn’t pay any attention to what they’ve done, because I don’t need to cover it. I just do what I need to do so that I can do the best I can”.

Tui offered another example of a limitation of the five-week practice. She felt that when she carried out assessment practices during the teaching practice she was only able to collect information over a short time frame. She described the practice as being, “like a snapshot”. Consequently, she was not able to collect assessment information that represented what children could do over an extended period. She was looking forward to having the longer timeframe of the year to carry out assessment practices, “next year, results will be based on the whole child’s knowledge, not just this one thing that you taught them while on PP”. For Tui, being able to teach over the full year meant that she would have a variety of opportunities, spread out over a longer period, to carry out assessment practices.

Participants indicated that they were excited about the prospect of being able to be left alone in a classroom without constantly having the presence of an associate teacher or a lecturer in the classroom with them. They expressed a feeling of relief that the assessment components of their courses were over and that they would finally be able to teach independently without constant supervision. Daniel saw this as an important part of the next stage in his learning. He said, “I’m looking forward to being legally left alone and not having someone continually watching me. I think that makes a huge difference.” When asked to clarify this, he said that he viewed “mistake making” as being an important part of the learning process as a beginning teacher. To be able to do this, he needed to be in an environment where he would not be judged by an associate teacher or a lecturer. He was not afraid of making mistakes in his first year; instead he was looking forward to being able to make mistakes in the privacy of his own classroom. He said, “It’s cool, if it doesn’t work then admit it to the kids and just be honest, that didn’t work. And start again. You develop your own style, get right into it”. He indicated that when on Professional Practice he did not have the opportunity to develop his own teaching style because he was always having to adopt and adapt to the teaching style of the classrooms that he was in.

Others were also looking forward to having the autonomy in their first year to develop and implement their own programmes. Both Marie and Glenys expressed their frustration at having to follow associates’ planning while on practice. Glenys said “being on practice helps with a whole lot of things, but you have to fit in with what your associate is doing. You don’t get to do what you would do yourself.” Later on in the interview she talked about looking forward to taking “ownership” of her programme, “taking ownership of the programme is going to be something quite exciting, rather than just following someone else’s,...you actually get to create your own thing.” Glenys cited a previous experience where her associate had directed the content of her planning without giving her the chance to develop her own ideas. She said, “On PP you get handed a little piece that you are teaching and the teacher’s already gone out and photocopied the lesson plan, and told you each week, as you plan it, she’ll check it and say you’ll do this and you’ll do this.” Participants were looking forward to being able to have the autonomy to make their own decisions about their programming and planning in their first year.

While participants were looking forward to finally having this independence in the classroom, there was a sense of anxiety expressed about the responsibility that went with this. Tui in particular acknowledged that in her role as a student teacher she liked having the security of knowing that her associate teacher was ultimately responsible for the classroom that she was teaching in. She said, “I feel like when I am on PP if something goes wrong that’s OK because I’m learning, and if something goes wrong when you’re the teacher it’s your, it’s up to you – it’s your responsibility.” She identified that having this ultimate responsibility would be a big change in her first year teaching. Other participants agreed indicating that this responsibility would add “pressure” that they did not have as pre-service teachers. Tui gave an example of this “pressure” as a beginning teacher when she talked about feeling pressured to “teach” children over the whole year. This was different to her professional practice experiences where she only had five weeks to “teach” the children in her class - “when you are on section, you’re there for a small amount of time, if you teach them something, you do, and it’s a bonus, pretty much, but if you don’t, there’s not that pressure on you”. For her, having the sole responsibility for the teaching and learning of the children in her class over a whole year, was a major shift from being a pre-service teacher to a beginning teacher, the difference being that, “it’s up to you”.

A common feeling shared by the participants was that their first year of teaching was a crucial step in the next part of their learning journey. Sarah and Tui expressed their feelings about this:

I think next year will probably be like, I don’t know, I think I’ll learn more next year than I have the last three years. I think it’ll be a crucial year. (Sarah).

I think it will be quite hard – I just want someone to give me a chance, that’s all. That’s all I want, for someone to just give me a chance, because I don’t know it now, but hopefully I will learn it (Tui).

While they had accumulated knowledge skills and experiences about teaching while they were at college, they still had a lot more to learn. Daniel articulated this further - “Just because we have left here doesn’t mean we have “nailed it!”

Kate described herself as, “a beginning teacher.....you’re emerging!” When asked to explain what she meant by this, she found this quite difficult. She explained that as a beginning teacher, she knew she had knowledge, skills and experiences to take into a school but acknowledged that despite this, she was still very much on a learning path about how to teach, “well you want to go into schools having learnt something. You’ve got this knowledge. As an emerging teacher you want something to go in with.” She saw the key difference between her present position and that of teachers in schools as being “experience” and the only way to get this experience was to teach. Other participants agreed that the next step was to actually get a job and “do the teaching”. They did not want to learn anymore about teaching by “just hearing about it” in college lectures.

Ellen and Daniel agreed that as beginning teachers they had valuable knowledge to take into a school. They discussed the planning tasks for the mathematics course i.e. the long-term plan and the unit plan as examples of knowledge that they felt confident to take into a school. They liked knowing about these tasks as it meant that they could work alongside teachers in their schools. They also felt strongly that they would have new knowledge that they would be able to share with “experienced” teachers. An example of this was their understanding of the new mathematics curriculum. They felt that in some cases they might know more about this curriculum than teachers in schools. They liked feeling confident to share this knowledge as a beginning teacher.

Ellen was looking forward to the “experience” of having taught in her first year. She said;

well I think once we’ve done the first year, we’ve taught all of the strands. We will have experience and we will know what works and does not work, we would have looked at the content, our second year of teaching is going to be so much better. It will be way more exciting, because you know, we’ll know what we need to improve on, and how to fit things together, it will be way better, we’ll learn heaps in the first year. Scary, but good.

She was looking forward to the learning about teaching that she would acquire in her first year and having a sense of achievement once the year was completed. She saw the first year as an important part of the ongoing learning process and was looking forward to “ticking it off her list”.

The participants in this study all agreed that while they had completed one stage of their journey having finished college, their next stage i.e. their first year of teaching, was ahead of them. There was a sense of excitement as they prepared for making this transition. The following quote from Marie summarises the feeling of the participants, “next year will be information overload but I’m *really ready for it*.”

This chapter has highlighted several important issues that pre-service teachers are concerned with as they anticipate teaching in their first year. These issues relate to curriculum knowledge, mathematical content knowledge, the long-term planning task and knowledge of future school contexts. Each of these findings is discussed in the following chapter.

## Chapter 5: Discussion

### Introduction

This chapter discusses significant findings from the results. The discussion is presented in four main sections; engagement with *The New Zealand Curriculum* (2007), mathematical content knowledge, “approximations of practice”- the long-term plan assignment and looking forward to the first year of teaching.

### ***Engagement with The New Zealand Curriculum (2007)***

A significant finding was that while the intention of the new curriculum was to provide a framework for teachers for developing their mathematics programmes, the participants found that it did not provide them with the specific information they needed. The two areas that were most problematic were the achievement objectives and the Venn diagrams.

A notable change between the old and the new curriculum was the reduction of the number of achievement objectives. This was done in response to the curriculum stocktake (McGee & Penlington, 2001), which noted that the old curriculum was overcrowded and had too many achievement objectives which teachers did not understand. McGee (2008) describes the content of the new curriculum as core knowledge that is considered suitable and desirable for all students to learn. While he suggests that the new achievement objectives are written clearly, the pre-service teachers found that in places they were too broad and lacked definition. In addition to this, some had difficulty understanding the mathematical terminology used in some of the achievement objectives.

In their efforts to seek clarity about the content of the achievement objectives, the pre-service teachers referred to resources external to the curriculum. The main resources were the old curriculum document, particularly the achievement objectives, the suggested learning experiences section and the glossary. They also used mathematical dictionaries to help define unknown terms e.g. Ellen seeking out the meanings of polygons and polyhedrons. Another resource was the units of work section on the nzmaths website. This site was trusted because, like the curriculum, it originated from The Ministry of Education. The units were beneficial because they included specific

learning intentions and described key mathematical ideas taught in each unit. This content helped the pre-service teachers gauge the length of each unit on their long-term plans. The information gained from the website and the old curriculum, assisted pre-service teachers to interpret the new achievement objectives.

The Venn diagrams, which serve to indicate suggested proportions of teaching time for each strand at each curriculum level, also posed problems. Like the achievement objectives, the pre-service teachers found these lacked definition, and had to guess the intended meaning based on knowledge gained from course work and their limited experiences working in schools. The prevalence of the numeracy project in schools and the larger proportion of time attributed to the number and algebra strand on the diagram, creates an impression that more time was to be spent on this strand than the others. Shulman (1986) states, “we expect teacher to understand why a given topic is particularly central to a discipline whereas another may be peripheral. This will be important in subsequent pedagogy judgments regarding relative curricular emphasis”(p. 9). While the intention of the Venn diagrams was to communicate emphasis and shifts in emphasis across the levels, in the absence of explanations and experience in the classroom the pre-service teachers had to guess the intended meaning.

Decisions about the amount of detail and prescription to be included in any curriculum are contentious (McGee, 2008). While teachers in schools, with experience or “wisdom of practice” (Shulman, 2004), may be in a position to develop a long-term plan from the broad framework provided by the new curriculum, pre-service teachers, without this experience, wanted the curriculum to provide them with detailed and specific information. This curriculum knowledge is important as it includes not only knowing the content of the achievement objectives at each level, but also knowing how it progresses and how to document this for teaching (Ball, 2000). The pre-service teachers were searching for specific curriculum knowledge to understand the content of the achievement objectives and to enable them to craft their long-term plans for teaching.



## **The Numeracy Project**

From their teaching experiences and interpretations of the Venn diagrams, the pre-service teachers were aware of the dominance of the numeracy project when completing their plans and they placed numeracy units onto their plans before units from other strands. While the curriculum objectives from the number and algebra strands were recorded onto their plans, the Numeracy Project was viewed as a discrete programme, separate to the new curriculum.

The pre-service teachers liked the prescriptive nature of the project, particularly the detail provided by the number framework and the teaching resources. Unlike the curriculum, this detail helped them to define what they had to teach and how they could teach it. The provision of resources also meant that they did not have to spend time sourcing resources for teaching as they had to with the other strands. Locating resources and then making decisions about their use in the classroom is a critical issue for pre-service teachers (Grossman & Thompson, 2008). The level of prescription provided by the numeracy resources meant that the pre-service teachers did not have to make decisions about teaching as this was already done for them. They trusted these decisions as the resources were written by the Ministry of Education. This gave biblical status to them, as illustrated by Tui's quote, "it is like a bible". They requested this level of support for the other strands i.e. "a geometry project". The detail provided not only guidance and support for their teaching but also helped them to feel secure that they would teach numeracy as it was intended.

Some pre-service teachers viewed the level of prescription as a limitation. Both Ann and Daniel commented that the prescription had the potential to constrain their teaching. While they valued the support provided by the detail, they were concerned that it could limit their ability to adapt and change the content and to take ownership for their own decisions. Typically, novice teachers adhere closely to resources and with experience adapt and adjust them for teaching (Grossman & Thompson, 2008). Ann and Daniel expressed a desire to do this once they had become familiar with the resources in their own classroom. Ellen acknowledged her desire to branch out and develop the project material, but knew that she needed to gain experience in teaching the material before she could change it for teaching. Daniel indicated that he felt a sense of urgency and authority about teaching numeracy "the correct way". This had

the effect of making him feel uncertain about his ability to interpret and implement the content as it was intended.

The Numeracy Project was viewed as beneficial by the pre-service teachers because it took away the responsibility for them to interpret the curriculum and to select resources. Pre-service teachers “are hungry for curricular guidance and often find little to help them, ending up overwhelmed by their responsibility in terms of creating quality curriculum materials.” (Kauffman, Johnson, Kardos, Liu and Peske, (2002) cited in Grossman & Thompson, 2008, p.2016). The Numeracy Project also provided a much needed expansion of the new curriculum content. While some felt constrained by this prescription, they acknowledged that gaining knowledge and experience about the project in their first year of teaching would allow them freedom in the future to adjust and adapt the content for teaching. This was a necessary part of the process of learning to teach.

### ***Mathematical content knowledge***

Another significant finding was the variation in the mathematical content knowledge of some of the pre-service teachers. In the process of completing the long-term plan assignment, the pre-service teachers recognised that they needed mathematical content knowledge to understand the content of the curriculum, particularly some of the terminology used in the achievement objectives. Having to define these by recording the key mathematics ideas on their long-term plan engaged them with the mathematical content to be taught in each unit.

Engagement with The Numeracy Project resources also highlighted the importance of content knowledge. There was concern about some of the terminology and the teaching approaches. They recognised that some of the teaching approaches were different to the ways they had been taught; this meant they had to relearn how to do, and therefore teach mathematics. This was exemplified by Ellen’s frustration at having to learn how to solve number calculations using mental strategies, as opposed to using written algorithms, which was the way she had been taught. Thomas (1999) describes this as “unlearning”, stating that at pre-service level, “there is as much to unlearn as there is to learn, about learning, knowledge, students and ways of teaching and assessing – all related to classroom practice”(p. 9). The numeracy project

strategies are an example of this. Ball (2000) suggests that time needs to be allocated within ITE programmes to allow pre-service teachers to unlearn what they have learned as school students, and to learn what needs to be done as a teacher, in particular the unlearning of rote procedures. Glenys identified that being able to do multiplication, did not mean she could teach it, as advocated by the numeracy project. She thought it was necessary to learn new approaches before she started teaching and relied on the numeracy resources to help her do this.

Glenys's example recognises that mathematical content on its own is not sufficient to teach mathematics effectively. Ball (2000) suggests effective mathematics teachers not only know the content of what they are teaching but also know how to transform this knowledge for teaching, "it is not just the mathematics [that] teachers know - but how they know it and what they are able to mobilize mathematically in the classroom"(p.5). Other studies concur with this, highlighting that teachers need content knowledge and pedagogical knowledge, to teach mathematics effectively (Hill et al. 1996, Ward & Thomas, 2007). The pre-service teachers in this study recognised and wanted mathematical content knowledge and knowledge of how to teach it before they began their first year of teaching.

### **Reliance on resources**

Reliance on teaching resources as a means for developing mathematical content knowledge was common amongst the pre-service teachers in the study. The main resources were; the old curriculum - particularly the old achievement objectives and the glossary sections, dictionaries, nzmaths website, teaching resources such as *The Figure It Out* series and *The Numeracy Project* resources. Tui was relieved to discover the content tutorials on the nzmaths website. These resources were valued because they defined mathematical content and provided options for teaching this content in the classroom. This indicates that resources are used for multiple purposes; to define unknown mathematical content and to select teaching and learning activities for the classroom. In some cases, certain resources were used like a mathematical tutorial. An example of this is when Ellen used the *Figure It Out* resources to help her define geometry concepts for a geometry unit on shape, specifically searching for definitions of polygons and polyhedrons. She consulted the resources to find these

definitions and then looked for activities to teach these concepts. As she said, “if it’s in the resources then that’s what I need to teach!” The resources defined mathematical content for teaching and provided ideas about how to teach it. Like Ellen, other pre-service teachers indicated that they trusted and relied on resources that were written and published by the Ministry of Education. They particularly liked resources that were aligned to the curriculum. They felt reassured using these resources, not just as resources for the classroom, but also as a means for learning the actual mathematical content that they needed to teach.

While there was a reliance on resources to learn content, participants own content knowledge limited the kind of learning gained from the resources. Sarah’s example of disregarding resources she did not understand is an example of this. In this case, her lack of content knowledge influenced her comprehensions and interpretations of the resources (Shulman, 2004). Thompson and Thompson (1994) cited in Ball (2000) suggest that lack of content knowledge can also result in teacher distorting content in resources. Grossman (1990) summarises the importance of beginning teachers having expected levels of content knowledge for teaching:

Beginning teachers’ knowledge of discipline affects their conceptions of what it means to teach a particular subject. Teachers’ subject matter knowledge also contributes to their selection of particular curricula material and to their critique of specific curriculum material (p. 12).

### ***“Approximations of Practice” - The Long-term Plan Assignment.***

This study did not set out to evaluate the long-term plan as an assignment. However, a significant finding is that the pre-service teachers in the study unanimously agreed that it was a beneficial task to complete before their first year of teaching and that it should remain as an assignment for the course. The main reasons for this were; it allowed them to engage with and interpret the content of the new curriculum, it helped them to develop mathematical content knowledge, helped them to become familiar with resources for teaching and allowed them to complete a task that ‘real’ teachers would do before their first year of teaching.

Grossman, Compton, Ingra, Ronfeldt, Shahan, & Williamson (2009) describe tasks such as the long-term plan as “approximations of practice”(p. 2077). These practices have value to pre-service teachers as they provide them with opportunities to enact and experiment with tasks in the university setting prior to their first year of teaching. One advantage was that the pre-service teachers were able to receive support, advice and feedback on the task within the security of the course because “approximations allow for errors that novices inevitably make when enacting complex tasks” (Grossman et al, p.2077). Guidance received in the course helped to prepare them for the reality of completing the task in a school.

The assignment required the pre-service teachers to complete a more detailed plan than what they would be expected in a school. The purpose of this was to give them an opportunity to focus in depth on both curriculum and content knowledge. ‘Approximations of practice’ typically differ to tasks carried out in schools (Grossman et al, 2009). While this may have made the plans less authentic, it had the benefit of allowing the pre-service teachers to focus in detail on curriculum and mathematical content within the course setting. Grossman et al (2009) state:

Approximations may require more elaborate versions of practice than what novices will enact later in their careers e.g. detailed plans. Although not being authentic they can provide opportunities for students to experiment with new skills, roles and ways of thinking, with more support and feedback than actual practice in the field. They require novices to be more detailed, making their thinking more visible (p. 2077).

The level of detail allowed the pre-service teachers to gain an in-depth understanding of both curriculum and content knowledge for use in future plans. This included knowledge of mathematics units they had not taught on Professional Practice. While they were unable to gain the experience of teaching all of the units on their plans, the act of preparing plans helped them to feel organised and ready to teach these plans in their first year.

Another advantage of completing the plan within the course was that it enabled the pre-service teachers to understand the purpose of a long-term plan. This was in marked contrast to their Professional Practice experiences where they were exposed to five-weeks of planning at a time. Daniel’s comment on receipt of a plan during

Professional Practice illustrates this, “I thought it was there to fill up my folder”. The plans gave them a framework and direction for their teaching. This was described as “painting a picture” (Kate) and “providing the big picture” (Glenys). The benefit of having an overview was that it helped them to feel prepared and organised for teaching, “I always feel more confident when I know where things are going – if it’s just random then I sort of feel lost, and it doesn’t give me direction” (Marie). The plans served as a mechanism for keeping them on a teaching path for the year ahead.

They were enthusiastic about completing an assignment that simulated a ‘real’ task they would be required to do in their first year of teaching. They realised that long-term planning was a task that they would do in the future as a teacher and were eager to experience this, before immersion in the reality of the classroom. The “realness” of the task enabled them to “put their teacher hats on” which was the positioning they were asked to adopt at the outset of the course. As well as knowing what to include on a plan, they liked knowing how to plan. Again, this was in contrast to their Professional Practice experiences where they had not been part of a planning process in a school. They now felt confident to be active participants in future planning experiences, and felt able to plan either individually or collectively with other teachers.

As well as recognising that the plan had value in supporting their teaching, they also saw it as a professional document that held status within a school setting. There was an expectation that future plans could be shown to ERO, principals, tutor teachers and other staff. They felt less intimidated by this future prospect having practised this task within the course. The value of the assignment in helping pre-service teachers to prepare for the classroom was so significant that they expressed a desire to replicate the process in other curriculum areas and in other courses before beginning teaching. The relevance of the task helped them to begin to transition from pre-service teacher to beginning teacher. Winsløw et al. (2009) note that this is a major challenge and transition for pre-service teachers to make; this task enabled them to begin to do this.

## ***Looking Forward To the First Year of Teaching***

### **Establishing routines for teaching**

In the interviews, the participants were asked to identify the concerns that they had about their first year teaching. A significant concern was how to set up and maintain their mathematics programme in the first few weeks of school. There were specific questions about what to prepare before starting to teach, what topics/units to teach in the first few weeks, what assessment procedures to use, grouping arrangements for teaching, and how to set up and manage routines on an ongoing basis. These concerns are similar to those expressed by the participants in Lang's (2001) study. While the pre-service teachers had gained knowledge of "best practices" for teaching from various sources, they had concerns about how to implement these practices in their own classrooms. McGee and Penlington (2001) suggest that this knowledge will develop with experience of developing and implementing these routines, and acknowledge this as a key difference between novice and experienced teachers.

An example of implementing "best practice" is the establishment of grouping arrangements for teaching mathematics. The pre-service teachers expected to follow the Numeracy Project model of grouping children by strategy stages, and to use a rotational system for teaching. They were concerned about how to group children at the beginning of year, how to implement the rotational system and how to maintain this system throughout the year. While on Professional Practice these routines were established by associate teachers, with pre-service teachers having to follow these for the time they were on practice. This highlights a limitation of the length of time spent on practice because their learning was confined within the boundaries and situations of each placement. The pre-service teachers described the placements as being discrete blocks of teaching and "snippets of time" (Kate). This meant they learnt within the context of each placement and were not privy to the implementation of pedagogical practices that occurred prior to their arrival on placement e.g. the establishment of systems for grouping students for mathematics. This meant that in their first year they would have to do this independently without previous experience, and without the support of associate teachers. Transforming this knowledge from their

professional practice classrooms to their own classrooms, presented a major challenge for the pre-service teachers.

They acknowledged that while on professional practice they had to adopt practices of their associate teachers. Zevenbergen (2006) agrees that pre-service teachers' experiences of teaching are reinforced and constrained by the teaching they see and have to adopt while on Professional Practice. For some pre-service teachers this constrained their teaching, providing little opportunity to make decisions about pedagogical practices. Ensor (2001) suggests that while on Professional Practice pre-service teachers can be constrained, because while they can recognise best practices they have limited opportunities to realise these practices for themselves being situated in someone else's classrooms.

While some did feel constrained, a positive aspect was that having experienced the practices of others, they were able to evaluate these for future use. An example of this was when Glenys and Marie had to implement 'group boxes' while on Professional Practice. This gave them an opportunity to evaluate them and make decisions about how to adapt this practice for inclusion in their own programmes. Another example is Ellen's resolve to have mathematics equipment well organised for teaching, having seen the consequences of not having it well organised. While they could not change associate teachers' practices, they provided a valuable source of knowledge, which pre-service teachers could reconceptualise for future use.

### **Teaching Measurement, Geometry and Statistics**

Another significant finding was that the pre-service teachers felt unprepared to teach some units of work from the geometry, measurement and statistics strands in the curriculum. Although they had developed these units within their long-term plans they had limited experiences of teaching these strands while on Professional Practice. They assumed this was because of the dominance of the numeracy project in schools, in the curriculum and in their course work. While the numeracy project adopted a group teaching approach, they assumed they would adopt a whole class teaching approach to teach these other strands and had several questions about how to do this. These included - how to organise equipment and resources, how to structure the lessons,



how to cater for individual needs and how to carry out assessment tasks in a whole class setting. Ensor (2001) suggests that beginning teachers recontextualise their knowledge for teaching in their first year by reproducing discrete tasks from their courses. The pre-service teacher's limited experiences of teaching measurement, geometry and statistics units, and whole class teaching arrangements, meant they had minimal knowledge of these areas to reproduce in their own classrooms. They wanted to have had an opportunity to explore pedagogical practices associated with these areas both in course work and in schools before their first year of teaching.

### **The reality of teaching**

An important realisation for the pre-service teachers was that after three years of their teacher education programme, they were finally at a point where they could transform from being a pre-service teacher to being a 'real' teacher. For Daniel this meant having the first real opportunity to develop his own teaching style. He was looking forward to being able to learn how to teach, by teaching without fear of being judged or evaluated, and without conforming to the practices of others. An important part of this learning process was being able to make mistakes and take risks. He saw the chance of ownership and independence in his first year as an opportunity to extend his teaching repertoire in the safety of his own classroom.

While the prospect of ownership and independence was exciting for the pre-service teachers, they were beginning to realise the professional responsibility that went with this. Tui realised that as the teacher she would have to take responsibility for behavioural issues, as opposed to associate teachers taking this responsibility. There was a certain amount of anxiety among the pre-service teachers who acknowledged this as a key transition they would have to make. While relishing the prospect of being alone in the classroom they still wanted and would need support from other teachers in their school. In addition, they expected and felt reassured about receiving support from tutor teachers and others in their schools. The pre-service teachers were looking forward to participating in reciprocal learning experiences with teachers in their schools. This meant being in a position to receive advice and guidance from others, and being able to share their knowledge with others e.g. knowledge of the new

curriculum. They wanted to be active participants in the teaching process as opposed to being passive participants, which they had been as pre-service teachers.

Another area of concern was knowing about the contexts they would be in. This included wanting to know about future schools, classroom levels, resource availability, assessment practices, planning systems and needs of children. While they could confidently prepare for the implementation of some of these aspects e.g. resource preparation, others were less tangible and could not be able to be addressed until they started teaching. Having completed this mathematics education course they were now aware of what to ask for when attempting to gather information about the pedagogical practices for teaching mathematics in future teaching contexts.

The first year of teaching was the crucial “next step” in their teaching journey. They had reached saturation point for learning within the context of their initial teacher education programme and were keen to learn within the context of future schools. The prospect of having their own classroom was the first real opportunity to develop and implement pedagogical practices on their own. Ellen described the anticipation of completing this first year as achieving a “milestone” in teaching and was looking forward to being able to “tick off” the first year.

The final chapter presents the significant areas of knowledge for teaching that the pre-service teachers in this study were concerned with as they anticipated teaching in their first year. The Pre-service Teacher Development Model is used to explain the process they engaged with to develop this knowledge, during their ITE programme.

## Chapter 6: Conclusion

### ***Summary of the research questions***

The first section of this final chapter responds to the research questions of this study.

#### *Research Question 1:*

*What are pre-service teachers' issues as they plan a yearly programme in maths?*

The pre-service teachers looked to *The New Zealand Curriculum* (Ministry of Education, 2007) for guidance about *what* to put on their plans and *how* to use this information to construct their plans. They found the achievement objectives were broad and did not have enough detail to support their planning and teaching. They wanted the Venn diagrams to provide information about how to form units of work from the achievement objectives for their yearly plans, but found minimal guidance. They interpreted the Venn diagrams by using the knowledge gained from their Professional Practice experiences and messages gained from course work. One of the inferences they made was to prioritise number teaching before the other strands. Consequently number units were placed on the long-term plans before units from the measurement and geometry and statistics strands.

To help clarify the content of the curriculum pre-service teachers referred to a variety of resources. Teaching resources were used for several purposes; to clarify curriculum content, to clarify mathematical content and to provide suggestions for possible teaching approaches. Resources that were written by the Ministry of Education, were perceived as having status and these were trusted by the pre-service teachers. They felt secure using these resources, expecting alignment with the curriculum content. At the time of this study several resources written by the Ministry of Education had not been updated to match the new curriculum content, which caused frustration for the pre-service teachers.

Some pre-service teachers had difficulty interpreting the curriculum because of their limited mathematical content knowledge. They acknowledged several reasons for needing mathematical content knowledge; to interpret mathematical terminology used in the achievement objectives, to identify mathematical concepts to be taught in each unit, to interpret resources, to decide on teaching approaches and for teaching. They relied on teaching resources to develop this knowledge, treating some resources like content tutorials. The actual 'content tutorials' on the nzmaths website were a popular resource. In the absence of a glossary in the new curriculum mathematics dictionaries were also used to clarify content.

In addition, the pre-service teachers relied on their professional practice experiences to inform their decisions about how to craft the achievement objectives into units for their long-term plans. They felt confident to plan units they had previously taught due to their knowledge of the scope of the units i.e. possible achievement objectives, length of time taken to teach the units and possible placements in the year. These teaching experiences not only clarified content for teaching but also acted as models to show how units could be constructed and organised for teaching. A constraint of professional practice experiences meant they had gaps in their knowledge of how to teach some units. The long-term planning task helped them to fill these gaps, by making them engage in content they had not taught.

*Research Question 2:*

*What are their emerging needs as they anticipate developing and implementing their mathematics programme?*

As the pre-service teachers anticipated developing and implementing a mathematics programme in their first year of teaching, they realised this was a beginning of the transition from being a pre-service teacher to a beginning teacher. An important aspect of this transition was, that they would have the autonomy to make their own decisions about which pedagogical practices they could adopt, which to discard, and which to adapt for their own classroom use. In their role as a pre-service teacher, teaching in someone else's classroom, they were obliged to adopt the practices of their associate teachers. As a beginning teacher with responsibility for their own class,

they could begin to make their own decisions about which practices to include in their own teaching repertoire.

Their immediate concerns related to beginning the school year. They wanted to know; what to do in their first few weeks of school, what units to start with, what assessments to use, how to group children for instruction, what resources to use and how to develop and manage their programme on an ongoing basis throughout the year. They realised they would have to wait until their first teaching position to gain some of this information, but were keen to find out tangible information that they could prepare before these first few weeks of school. This key information related to class levels and numbers, resource and equipment availability, assessment information and school programmes for teaching mathematics. Several pre-service teachers expressed a desire to be prepared for teaching before the school year began.

Another aspect of transitioning into the classroom, was the prospect of being “left alone” to teach without the presence of an associate teacher. They were looking forward to learning to teach in a setting where they could take risks, make mistakes, and learn from these mistakes without the anxiety of being observed and assessed. Daniel and Ellen described this as being able to develop their “own teaching style”. While on professional practice they had been constrained, because they were expected to implement the teaching practices of others.

While this was seen as a positive aspect of transitioning into the classroom, some pre-service teachers felt daunted by the responsibility and autonomy that went with the shift in role. They expressed a need to have support from the schools, and hoped this support would come from sources such as school policy and planning documents, resources, teaching colleagues, and management structures within schools. They viewed their first year of teaching as the crucial next step in their learning-to-teach journey. The fragmented nature of their Professional Practice experiences meant they had taught in short five-week blocks. The first year of teaching would be their first opportunity to teach over an extended period of time, and they hoped they would have support throughout this year to complete this milestone.

### ***Knowledge for teaching mathematics***

A summary of the results from both research questions, indicate that these pre-service teachers are concerned with knowing; the content of *The New Zealand Curriculum* (2007), how to teach this content, including mathematical content in future school. These categories of knowledge for teaching are:

- *knowledge of the curriculum i.e. knowing curriculum content (including related resources), and how to teach it in the primary classroom*
- *knowledge of mathematical content i.e. knowing mathematical content for self and for teaching*
- *knowledge of contexts i.e. knowing the characteristics of learners and requirements of each unique school setting*

Each of these categories concur with both Shulman's (1986) and Grossman's (1990) categories of knowledge for teaching. From the perspective of the pre-service teachers in this study, knowledge needed for teaching mathematics can be summarised as *knowing the curriculum and mathematical content, in ways, which can be enacted in unique school contexts, to ensure learning occurs.*

### ***How pre-service teachers learn to teach mathematics - the pre-service Teacher Development Model.***

This study has not only identified *what* pre-service teachers learned about teaching mathematics in a primary school, it has also identified *how* they learned this knowledge. The results confirm that during the experience of their ITE programme and as they anticipate teaching in their first year, they construct knowledge for teaching by engaging with the process of *recognising, reconceptualising and realising* knowledge for teaching. I explain these processes as follows:

***Recognising:*** The pre-service teachers learned knowledge for teaching mathematics by recognising aspects of ‘best practice’ from the different sources of knowledge provided by their ITE programme. This included noticing ideas about pedagogical practices within course work and while on Professional Practice. This knowledge added to their existing knowledge i.e. their “intellectual biography” and continued their understanding of what to teach in mathematics and how to teach it in a primary school. During their ITE programme, the main areas of knowledge that influenced their mathematics teaching were the curriculum and related resources, mathematical content, and contextual information from different school settings.

***Reconceptualising:*** This study has shown that to reconceptualise knowledge for teaching pre-service teachers needed to learn about the theory and practice of teaching from both course work and Professional Practice experiences. While course work aims to provide a “privileged repertoire” for mathematics teaching, the professional practice experience provided an opportunity to see this repertoire enacted in the classroom. While learning about theory and practice discretely has value, it is the integration of these areas that enables pre-service teachers to construct their knowledge for teaching.

The use of resources was a significant experience for reconceptualising content for mathematics teaching. The pre-service teachers relied on resources to help them make sense of the curriculum content and mathematical content for teaching. When working with resources they were looking to see how resources clarified curriculum content and suggestions for teaching approaches to adopt to teach this content. They also looked to resources to teach them mathematical content. The long-term planning task also had value as it engaged them in reconceptualising curriculum content and mathematical content for teaching. The process of completing the plan helped bridge the gap between theory and practice as it transformed curriculum knowledge, from a passive document, into a teaching plan for action in the classroom.

***Realising:***

As the pre-service teachers approached the end of their ITE programme, they could only anticipate the reality of future teaching experiences. A challenge they faced was transforming their knowledge about teaching from the ITE setting to future school

settings. While they could make tentative decisions about practices, they would have to wait until their first teaching position before they could realise these in their own classrooms. An important difference in their first year of teaching was, that unlike their Professional Practice experiences, they had an entire year to implement their intended repertoire. Therefore, they were eager to begin and experience this next part of their teaching development, with appropriate support from their future schools.

The positioning adopted by the mathematics education course helped to shift them from pre-service teachers to beginning teachers, by expecting them to engage in the course using the lens of a teacher and by requiring them to complete authentic teaching tasks such as the long-term plan. The long-term planning task had value because it simulated a process “real” teachers would do. The pre-service teachers felt confident to replicate this process in their first year, either independently or collegially.



The following diagram extends the pre-service teacher development model of Figure 2.1 by combining the process of how pre-service teachers learn to teach mathematics with the categories of knowledge needed for teaching as identified by the pre-service teachers in this study.

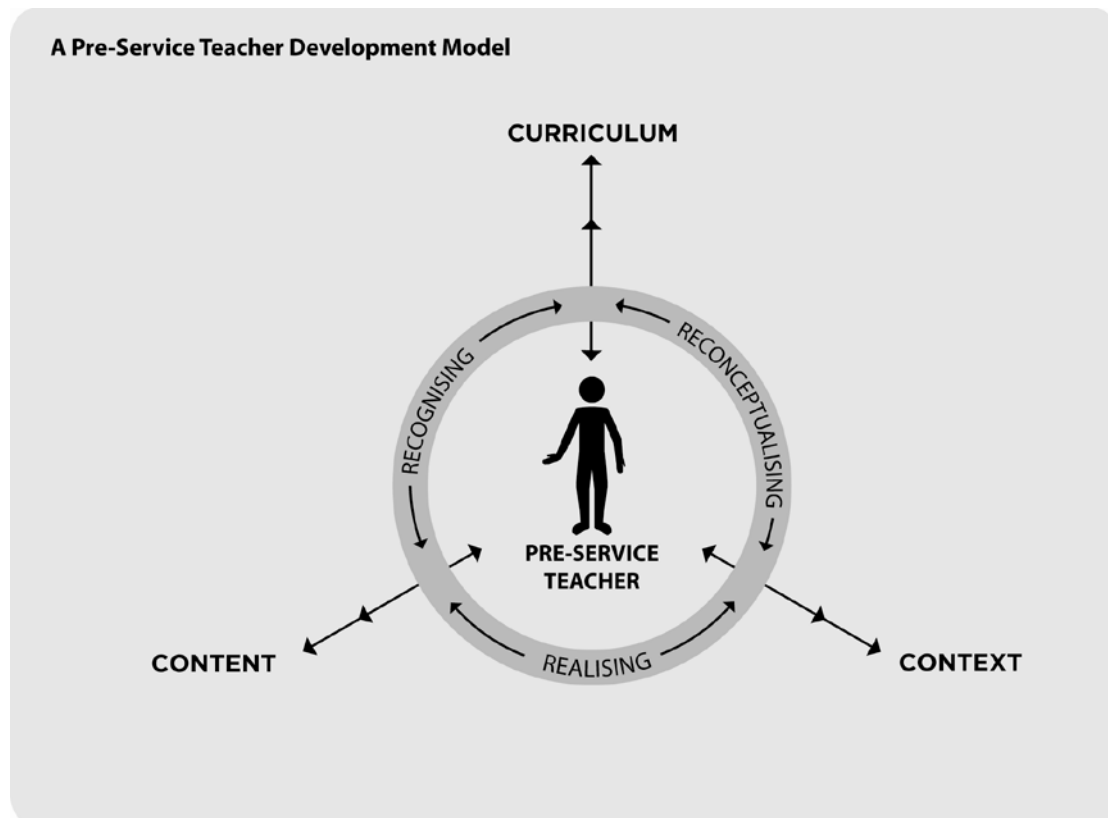


Figure 6.1: The Pre-Service Teacher Development Model

The pre-service teachers are positioned at the centre of the diagram. They develop knowledge of the curriculum, content and context by recognising, reconceptualising and realising this knowledge from various sources. These identified sources are the knowledge they bring with them i.e. 'their intellectual biography' (Shulman, 2004), their course work, and their professional practice experiences. This process of learning is not a linear process. The participants in this study were all unique learners who developed their understandings over time and in different settings. Therefore, the model of their learning process is illustrated as being fluid, with each part of the process being accessible to pre-service teachers at any time. It is presented in a circular manner to represent the backwards and forwards motion of knowledge construction. Knowledge categories are presented discretely, but like the learning

process each area is developed at different times, depending on the experiences of pre-service teachers during their Initial Teacher Education program. It is the interplay between knowledge acquisition and the process of learning, which culminates in the development of knowledge for teaching.

### ***Implications of this study***

Given the pre-service teachers' need to know about curriculum, content and contexts, I now present implications linked to these findings. While the new curriculum was written to provide a framework for teachers, a resounding finding from my study was that it does not have enough detail to support the planning and teaching of pre-service teachers. This study has shown the pre-service teachers needed to spend time seeking resources in order to gain further knowledge about the curriculum. This implies that the resources that were available to the pre-service teachers, at the time of this study, have limited use. They indicated a desire for the curriculum to contain more detail, for supplementary resources to be made available at the same time as the curriculum was introduced, and for existing resources to be updated to align with the curriculum content. They also wanted access to a comprehensive mathematics glossary to help develop their understanding of unknown mathematics terminology. These actions would assist pre-service teachers to plan and implement mathematical programmes.

This study has highlighted that some pre-service teachers will begin teaching with limited mathematical content knowledge. Their levels of content knowledge may influence their understanding and implementation of the curriculum, and their interpretation and use of resources. Greater understanding of mathematical content often results in greater confidence to teach mathematics. Therefore, some pre-service teachers may select to teach class levels in schools that match their mathematical ability. Mathematical content knowledge could determine the selection of future teaching positions. The graduating teacher standards require pre-service teachers to graduate from their ITE programme with adequate levels of mathematical content knowledge for teaching. This means that ITE lecturers need to evaluate minimal entry requirements in mathematics to ensure pre-service teachers are sufficiently knowledgeable to teach the curriculum. This includes making provisions within programmes to develop and transform this knowledge for classroom mathematics

teaching. This may also include providing opportunities for pre-service teachers to “re-learn” mathematical content to align with current pedagogy. The Numeracy project teaching approaches are an example of this.

Ball (2000) suggests the components of ITE programmes need to focus on the content knowledge needed for teaching, an understanding of how this knowledge is held by pre-service teachers, and what it takes to learn to use this knowledge in practice. The pre-service teachers in this study identified course work and Professional Practice components of their programme as valuable settings for learning how to teach mathematics. Course work was valuable to learn about content and pedagogy for teaching mathematics, while Professional Practice experiences provided an opportunity to realise this knowledge in the classroom. The implication of this is that pre-service teachers learn how to teach mathematics through a combination of both theory and practice. This study confirms Bernstein’s work, cited in Ensor (2001) that in order to learn about teaching, pre-service teachers need access to both ‘recognition and realization rules’ about teaching. Discrete programme components within an ITE programme need to complement and integrate with each other, to maximise the learning from each experience (Grossman, 1990). If programme components are kept separate, the learning gained in each is likely to be disconnected.

ITE lecturers are charged with deciding how best to deliver course content. This means evaluating delivery modes such as lectures, workshops and independent work. The pre-service teachers in this study indicated they liked being in a position to construct their own learning. The long-term planning task is an example of this because it engaged pre-service teachers in a process whereby they constructed knowledge about the curriculum, mathematical content and planning processes. They also liked the task because it placed them in the role of a ‘real’ teacher. This implies there is value in selecting learning experiences that promote the pre-service teacher to construct their learning, and places them in the role of the teacher. Therefore, ITE lecturers should evaluate both delivery modes and learning experiences, particularly assessment requirements, which are effective in preparing pre-service teachers for diverse classroom contexts.

While the Professional Practice component of the ITE programme had value, it also had several limitations. One limitation was the length of each placement. The first year of teaching will therefore be the first opportunity for pre-service teachers to teach over an extended period of time. Another limitation was the minimal experiences of teaching mathematics units, meaning that they will have new mathematics teaching experiences in their first year. A third limitation was the obligation to adopt the practices of their associate teachers. Therefore, the first year will be the first opportunity to have autonomy and to take responsibility for their own class. The pre-service teachers desired and were relying on support and guidance from future schools to assist them through the challenges of their first year. In New Zealand, it is acknowledged that the first two years of teaching are a continuation of the learning process from an ITE programme. There has been recent emphasis and development of advice and guidance programmes (Ministry of Education, 2007). This study has highlighted several areas that could be the focus of these programmes for beginning teachers; sustaining teaching over the whole year, supporting them to develop in the role of the teacher, and supporting their teaching of mathematics curriculum content for the first time. Mathematics curriculum development would also have the benefit of developing mathematical content knowledge.

ITE programme are responsible for preparing pre-service teachers to teach. As the pre-service teachers prepared to transition from this setting to the next they are faced with a number of challenges. This study had highlighted that pre-service teachers value knowledge of curriculum, content and school contexts as they head into their new schools. It has also highlighted that in order to keep learning they need to have opportunities to continue to *recognise* and *reconceptualise* this knowledge for teaching. This means that included in their advice and guidance programmes they need opportunities for professional development both with colleagues in their schools and also beyond their schools. While experienced teachers have a teaching repertoire to draw on, beginning teachers are only just starting to develop this:

Experienced teachers may possess rich repertoires of metaphors, experiments, activities or explanations that are particularly effective for teaching a particular topic, while beginning teachers are still in the process of developing a repertoire of instructional strategies and representations (Grossman, 1990, p. 9).

By being able to continue to recognise and reconceptualise practices for teaching mathematics these beginning teachers will be able to *realise* these practices in their own classrooms, and develop their own ‘privileged repertoire’ for teaching.

A worthwhile extension of this study would be to research beginning teachers as they transition into the role of a beginning teacher, and to investigate what knowledge for mathematics teaching they develop and how they develop this in their first year of teaching. In particular, I am interested to learn how they develop curriculum knowledge and how this knowledge is enacted in their mathematics programmes. This also includes how mathematical content knowledge affects their mathematics teaching, and how they develop this knowledge as they teach. I am also interested in investigating the use of The Pre-service Teacher Development Model as a basis for ongoing professional development.

An unexpected strength of this study was the honesty and willingness of the pre-service teachers to share their views of their ITE experiences. As stated in the beginning, this study did not set out to evaluate the mathematics curriculum course, however, thanks to the participation of the pre-service teachers in this study, I now have valuable insights to guide my future course planning decisions. Each year I attempt to place the needs of the pre-service teachers at the centre of the course; future research with beginning teachers would benefit from also placing them in this position. This would provide a view into the world of their first year of teaching.

### ***The Emerging Teacher***

The participants in this study were positioned in a unique place. They were on the cusp of finishing their ITE programme and anticipating becoming beginning teachers. Kate referred to this position as being “emergent” i.e. “emerging” from three years of the her ITE programme. When asked to define what she meant by this, she explained it was problematic and difficult to describe saying, “you know, we are emerging”.

A dictionary definition defines the term “emerge” as being “to rise from, to become apparent or known, to develop or evolve as something new and improved”. This definition, combined with Ann’s description, describes the position the participants were in. They saw themselves as “rising” from their ITE programme, their knowledge about the teaching of mathematics was becoming apparent and known, and they were developing and evolving as something new and improved.

In one sense, the “emergent teacher” aptly describes the pre-service teacher, but it also describes all teachers. The process of teaching is continually about evolving practice as something new and improved. All teachers are involved in an ongoing process of developing pedagogical content knowledge for teaching. Shulman (2004) describes the complexity of pedagogical content knowledge in any subject as being “both a handful and mind-full” (p. 513). Teachers have “a mindful” of ideas and practices, from which they select their “handful” for implementation in the classroom. The learning process of *recognising*, *reconceptualising* and *realising* allows them to grasp these handfals and then teach. This study has served to highlight the knowledge needed for teaching and how this knowledge is developed from the perspective of “emerging” pre-service teachers.

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## Appendix A

Needs assessment sheet for EDMS 372  
(Please record specific questions.)

<b>1. MiNZC/Number Framework/2008 curriculum</b>	<b>2. Beginning the school year.</b>	<b>3. Long Term Planning</b>
<b>4. Long Term planning workshop</b>	<b>5. Unit Planning</b>	<b>6. Group teaching</b>
<b>7. Resource selection</b>	<b>8. Unit planning workshop</b>	<b>9. Maintenance</b>
<b>10. Numeracy project update</b>	<b>11. School visit</b>	<b>12. School visit follow up</b>
<b>13. Assessment</b>	<b>14. Integration</b>	<b>15. Conclusion</b>

### 3. What considerations needed to be made when completing the plan?

## Appendix C The long term planning assignment template

### Term 1

Week	Mathematics Unit	Key Maths Ideas	Context
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

### Term 2

Week	Mathematics Unit	Key Maths Ideas	Context
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

### Term 3

Week	Mathematics Unit	Key Maths Ideas	Context
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

### Term 4

Week	Mathematics Unit	Key Maths Ideas	Context
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

## **Appendix D**

### **Focus Group Interview Questions**

#### Interviews 1 and 2

What is the purpose of the long-term plan?

What did you need to know to be able to design the plan?

What support material did you use?

How useful was the key maths ideas column and why?

How does the plan help you to prepare for your first year of teaching?

#### Interviews 3 and 4

Why is it important to have a “big picture of planning?”

Having completed the course, take a moment to visualise yourself in your first classroom. What are the important issues about teaching mathematics that you are thinking about?

What do you need to do to further develop as the mathematics teacher you want to be?

What other concerns do you have as you prepare to teach mathematics?

Any other comments?



